# FISCAL YEAR 1986 NOAA AUTHORIZATION

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# HEARINGS

BEFORE THE

SUBCOMMITTEE ON NATURAL RESOURCES,
AGRICULTURE RESEARCH AND ENVIRONMENT

OF THE

COMMITTEE ON
SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

NINETY-NINTH CONGRESS

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*Ranking Republican Member.
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# FISCAL YEAR 1986 NOAA AUTHORIZATION

THURSDAY, MARCH 7, 1985

House of Representatives, Committee on Science and Technology, Subcommittee on Natural Resources, Agriculture Research and Environment,
*Washington, DC.*

The subcommittee met, pursuant to notice, at 2:15 p.m., in room 2325, Rayburn House Office Building, Hon. James H. Scheuer (chairman of the subcommittee) presiding.

Present: Representatives Scheuer, Wirth, McCurdy, Meyers, Smith, and Henry.

Staff present: Dr. Robert Palmer, science consultant.

[The prepared opening statement of Mr. Scheuer follows:]

# HON. JAMES H. SCHEUER
# OPENING STATEMENT
# ON
# NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
# FY 1986 AUTHORIZATION

MARCH 7, 1985

THE SUBCOMMITTEE WILL
COME TO ORDER.

TODAY THE SUBCOMMITTEE
ON NATURAL RESOURCES,
AGRICULTURE RESEARCH
AND ENVIRONMENT IS
HOLDING THE FIRST IN
A SERIES OF HEARINGS
ON THE FY 1986 BUDGET
REQUEST FOR NOAA -- THE
NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION.

WE ARE PLEASED TO WELCOME AS OUR ONLY WITNESS TODAY DR. TONY CALIO, WHO WILL BE MAKING HIS FIRST APPEARANCE BEFORE THE CONGRESS IN HIS CAPACITY AS ACTING ADMINISTRATOR OF NOAA.

THERE ARE A NUMBER OF IMPORTANT POLICY QUESTIONS THAT WE WILL CONSIDER IN EXAMINING THE NOAA FISCAL YEAR 1986 BUDGET REQUEST.

THE BUDGET REQUESTS A REDUCTION IN REAL TERMS OF OVER 25 PERCENT.

WE WILL WANT TO HEAR DR. CALIO'S VIEWS ON HOW HE PLANS TO FULFILL NOAA'S MANY CONGRESSIONAL MANDATES WITH THESE REDUCED FINANCIAL RESOURCES.

FURTHER, A DISPROPORTIONATE SHARE OF THIS REDUCTION SEEMS TO BE IN OCEANS PROGRAMS AND IN THE AREAS OF RESEARCH AND DEVELOPMENT.

THE QUESTION IS WHETHER THESE TRENDS SIGNAL A FUNDAMENTAL SHIFT IN THE AGENCY'S GOALS.

BUT WHILE THESE BUDGETARY QUESTIONS ARE IMPORTANT, DR. CALIO, YOUR AGENCY FACES EVEN MORE SERIOUS CHALLENGES.

SINCE 1981, NOAA HAS LOST THE CLEAR SENSE OF MISSION THAT HAS INFUSED THE AGENCY SINCE ITS CREATION IN 1970.

THERE ARE A NUMBER OF REASONS FOR THIS MALAISE.

FIRST AND FOREMOST IS THE WAY THAT THE CONGRESS AND THE ADMINISTRATION HAVE BANDIED NOAA'S BUDGET BACK AND FORTH LIKE A SHUTTLECOCK FOR THE PAST FOUR YEARS.

THE SPECTACLE WOULD BE AMUSING WERE IT IS NOT SUCH A TOTAL WASTE OF TIME, EFFORT, AND MORALE.

IN ADDITION, FROM ALL REPORTS, THE TOP MANAGEMENT IN NOAA OVER THE PAST FEW YEARS HAS BARELY BEEN ON SPEAKING TERMS WITH EACH OTHER.

MEANWHILE, LARGE REORGANIZATION SCHEMES HAVE BEEN OFFERED AND SUMMARILY DROPPED, AND PRIVATIZATION SCHEMES HAVE BEEN REJECTED DUE IN PART TO POSSIBLE CONFLICTS-OF-INTEREST.

IN SUM, NOAA HAS BECOME POLITICIZED.

IN THE PROCESS, THE MISSIONS FOR WHICH THE AGENCY WAS CREATED -- OCEANIC AND ATMOSPHERIC RESEARCH AND SERVICES -- HAVE SUFFERED.

DR. CALIO, WE WANT TO HEAR YOUR VIEWS ON HOW WE IN THE CONGRESS CAN WORK WITH YOU TO GIVE NOAA A NEW SENSE OF DIRECTION.

IT IS CLEARLY TIME THAT THE ADMINISTRATION AND THE CONGRESS OPEN A CONSTRUCTIVE DIALOGUE THAT WILL REMOVE YOUR AGENCY FROM THE TRENCHES OF POLITICAL WARFARE.

WE ALL ARE INTERESTED IN THE SAME GOALS FOR NOAA -- COST-EFFECTIVE PUBLIC SERVICES AND A HIGH-QUALITY, WELL-FOCUSED RESEARCH CAPABILITY -- AND WE LOOK FORWARD TO HEARING YOUR VIEWS ON HOW WE CAN REACH THESE GOALS TOGETHER.

Mr. McCurdy. On behalf of subcommittee chairman, Mr. Scheuer, I want to welcome Dr. Calio today for the NOAA authorization hearings. The chairman has to speak on the floor on the Select Committee on Narcotics and asked that I fill in for him for awhile and since this is an area of interest for myself I was delighted to have the opportunity and I understand that the Deputy Administrator has a prepared statement which can be admitted into the record and if he'd like, unless there's a comment by the minority, then we'll go ahead and proceed with your statement, Dr. Calio.

## STATEMENT OF DR. ANTHONY J. CALIO, DEPUTY ADMINISTRATOR, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Dr. Calio. Thank you, Mr. Chairman, members of the committee, subcommittee. I really appreciate the opportunity to discuss with you today the National Oceanic and Atmospheric Administration programs and policies. My statement will highlight the major activities of the National Weather Service, the Office of Oceanic and Atmospheric Research and the National Environmental Satellite, Data, and Information Service based on the fiscal year 1986 budget submission.

In the Weather Service our fiscal year 1986 budget includes a new line item for public warning and forecast systems. This line item requests funding for the development and acquisition of major systems for the National Weather Service. Recent technological developments and the need to replace obsolete equipment offer the Weather Service the opportunity to improve its warnings and forecasts by acquiring these new technologically advanced systems. Moving these programs under one line item provides for a combined review of systems in one section of the budget.

The Weather Service systems upgrades for the next decade include: automated surface observation systems, next generation weather radar, with Doppler capability to provide nationwide coverage for timely accurate detection of severe storms and floods, an advanced weather interactive processing system to integrate, process and transmit high-volume radar, satellite, upper air, and surface observation data.

The cornerstone of our Local Warning Program is weather radar. We remain committed to replacing the existing obsolete weather radars with an effective modern system which will serve the Nation well into the next century. NEXRAD, as we call it, is a joint Department of Transportation, Commerce, and Defense effort to develop an advanced Doppler system. Our fiscal year 1986 budget request of $12.9 million to complete the NEXRAD radar system is for the validation phase. During the validation phase our two contractors will produce a radar system for evaluation. Because off-the-shelf, commercially available Doppler radar has improved over the past few years, we will also evaluate these systems in fiscal year 1985 to identify the most cost-effective Doppler weather radar system or mix of systems that meets the Nation's needs.

In the last few years we have witnessed an exciting series of developments in our ability to forecast small-scale weather phenomena. At the National Severe Storms Forecast Center we have used a pilot interactive computer-based system which permits forecasters to integrate radar, satellite and other meteorological data when making forecasts. The Program for Regional Observing and Forecasting Services, called PROFS, was developed at the Environmental Research Lab and applies the interactive computer procedures to improve our short-range, severe weather warnings and alerts.

In order to make the features of this new interactive computer system available in the field for the National Weather Service, our fiscal year 1986 budget requests $2.5 million to initiate the Advanced Weather Interactive Processing System. The AWIPS systems, which will replace the existing what we call AFOS, which is really automated field operation and service system, excuse the acronym, sir, it will replace the existing system in the 1990's and will improve the communication and processing of our observational data and forecasting products. AWIPS, the new system, will increase our ability to provide better warnings and forecasts to the public. Our fiscal year 1986 budget request supports the basic mission of the Weather Service to provide essential forecasts, warnings and advisories for the protection of life and property and to promote economic development by supplying other Government agencies and industry with timely weather and climate services. We propose to decrease or eliminate funding for programs which are no longer necessary, are low priority, or are not Federal responsibilities.

We are not proposing any general weather station closings. We are not—excuse me. To reduce the overhead, our fiscal year 1986 budget requests the consolidation of Pacific and Alaska Weather Service Regional Offices and proposes the closing of Regional—Southern Regional National Weather Service headquarters. These offices provide field managerial support, and I underline that field managerial support, have no forecasting or data gathering responsibilities. Staff reductions in fiscal year 1986 budget will result in a more efficient staff structure without detriment to key service delivery. We are seeking to terminate the fiscal year 1985 budget add-ons for NOAA weather wire and radio and the Colorado River Basin Flood Warning System.

Providing specialized weather services for specific user groups is not a Federal responsibility. Agricultural, fruit frost and some fire weather services are discontinued in our fiscal year 1986 budget. Continued fire weather services for Federal forest lands will be provided by the National Weather Service on a reimbursable basis from the Department of Interior. General public forecasts will be available to these industries, specialized forecasts should be provided to industry by private sector meteorological firms. Our goal is to devote resources to improving our ability to get fast, accurate weather warnings and alerts to the general public.

In Oceanic and Atmospheric research, NOAA's office of research conducts research and development for other NOAA components and Federal agencies, as well as the private sector, and atmospheric, marine and space research communities. The Office of Oceanic and Atmospheric Research Programs range from technological development to improve our ability to predict meteorological and climate conditions to investigations of fundamental physical and chemical properties of the atmosphere and hydrosphere.

Our fiscal year 1986 budget request enhancements are two, in our Atmospheric Research Programs. One is the development of an instrument called a PROFILER at $3 million and the other is a scientific investigation called Radiatively Important Trace Species Program, at $200,000. Major efforts in both areas began in 1985, PROFILER at $3 million and the Trace Species at $1.3 million.

The Office of Research's Wave Propagation Laboratory is developing a doppler radar system called the PROFILER for remote measurement of wind profiles and precipitation fields within severe storms. In fiscal year 1986 we propose to begin procurement and testing of 30 PROFILERS.

The Trace Species Program, which started in fiscal year 1985, involves research and monitoring to test a theory that certain trace constituents of gases and aerosols, like nitrous oxide, methane, chlorofluorcarbons and tropospheric ozone, contribute to the warming of the Earth's atmosphere. This so-called greenhouse effect could, in the long term, cause significant global climatic changes affecting rainfall and food production patterns.

We are seeking the same level of funding in fiscal year 1986 for NOAA's participation in the National Acid Precipitation Assessment Program as in fiscal year 1985; namely, $4.4 million. NOAA is developing techniques to measure dry deposition of acidic materials and the source, extent and transport of wet and dry acidic materials.

NOAA will continue its research on El Nino in fiscal year 1986. This El Nino research is carried out by several nations participating in the Tropical Ocean Global Atmosphere program, called TOGA. NOAA is the lead U.S. TOGA participant. Recently developed models have been successful in simulating ocean conditions in the equatorial Pacific during the 1982-83 El Nino event. This model will be adapted for operational use in 1986.

Investigation of the ocean's role in climate variability over longer periods is conducted through the Sub-Tropical Atlantic Climate Studies [STACS], which develops techniques to monitor the processes by which the North Atlantic Ocean transports excess solar heat northward or poleward from equatorial regions. After successfully developing these electromagnetic techniques for monitoring the Gulf Stream off Florida, this program will then extend its investigations into the Caribbean and the windward passage to determine the magnitude of the Florida Current transport and variability.

Our fiscal year 1986 budget will allow for continuing 24 hour, 7-day-a-week access to NOAA's Space Environmental Laboratory Data Acquisition and Display System, which provides solar-terrestrial data for the Government, industry and foreign governments. This information is vital for communications as well as air and space travel, which can be disturbed by magnetic storms or solar flares.

In fiscal year 1986, NOAA plans a Fisheries Oceanography Coordinated Investigation initiative to acquire the information needed to understand and predict the effects of environmental variability on major U.S. fishery resources. This is a multidiciplinary research effort, which is being conducted initially on a large mass of pollock recently discovered in the Shelikoff Strait in Alaska.

On objective of NOAA's research in marine warning and forecasting is to develop advanced forecasts of sea ice as an aid to fisheries and navigation. In cooperation with the Office of Naval Research, NASA and the Coast Guard, NOAA has completed a study of sea ice drift and ice edge behavior in the Bering Sea and will begin work in the Beaufort Sea in fiscal year 1986.

Decreases are being proposed for low priority research programs or for programs which have accomplished their goals. We can now reduce the PROFS Program, I mentioned earlier in my statement, by $2 million. PROFS has been an experimental program. Its results will be applied to the operational field system, AWIPS, that I described earlier and which we would begin developing. The Global Atmospheric Research Program, GARP will be reduced by $1 million. The first GARP Global experiment data set was collected in 1979 and we have been studying this data for 5 years. We can now phase down concentrated data analysis. We will continue research on long-range and short-term climate forecasting based on this early global experiment data. We plan to eliminate the weather modification grants program of approximately $2.6 million. This program's results have been inconclusive and these grants to States are not a Federal responsibility. We will terminate funding for the one-time fiscal year 1985 add-on for research on mesoscale convective systems.

The National Environmental Satellite, Data and Information Service budget items of interest to the subcommittee include procurement and operations of the polar and geostationary weather satellites and the collection, archiving and dissemination of environmental data and information.

In fiscal year 1986 we are seeking increased funding of approximately $59 million. Most of this increase will allow us to continue the procurement of GOES I, J, and K, which began in fiscal year 1984, and add the procurement of two additional satellites and launches. In addition the GOES next program will significantly improve the satellites to monitor severe storms and hurricanes through improvements in soundings and imaging resolutions. These actions will put the GOES Program on a sound and operational basis, while reducing the cost per spacecraft.

We are proposing two increases and one decrease in our fiscal year 1986 budget for GOES ground systems. In order to prepare for the initial transition of ground equipment and facilities for the GOES next satellite series, obsolete computer equipment must be replaced to allow for system expansion. An increase of $3.9 million is requested to upgrade the data collection system to meet additional user needs. We are requesting a decrease of $683,000 for a program started in fiscal year 1983 to replace and modify system components and for a program started in 1985 to augment the GOES ground system capability. This decrease is requested due to reduced program requirements.

In fiscal year 1986 a joint NOAA/DOD study will be initiated to determine our joint requirements for environmental Earth-observing satellites and how to better coordinate the use of our polar orbiting system. We seek a fiscal year 1986 decrease of $10.96 million to move to one polar configuration. The search and rescue system capability will be continued.

Funding for data and information services, global data and information for commerce, industry, agriculture, science and engineering and the general public and all levels of Government, will continue at the fiscal year 1985 level.

We have tried over this past year to recognize the severe Federal deficit and we have separated those elements which we think are nice to have from those things that we think we need to have. And we must work collectively in the future to determine the appropriate role of the Federal Government and establish our mutual priorities.

Mr. Chairman, I'll be pleased to answer any questions that you or members of the subcommittee would have. Thank you.

[The prepared statement of Mr. Calio follows:]

ANTHONY J. CALIO
DEPUTY ADMINISTRATOR
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

before the

SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURAL RESEARCH
AND THE ENVIRONMENT
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

March 7, 1985

Mr. Chairman and Members of the Subcommitee:

I appreciate having the opportunity to discuss with you the National Oceanic and Atmospheric Administration's (NOAA) programs and policies.

My testimony will highlight the major activities of the National Weather Service, the Office of Oceanic and Atmospheric Research and the National Environmental Satellite, Data and Information Service based on our FY 86 budget submission.

## The National Weather Service

Our fiscal year 1986 budget includes a new line item for "Public Warning and Forecast Systems". This line item requests funding for the development and acquisition of major systems for the NWS. Recent technological developments and the need to replace obsolete equipment offer NWS the opportunity to improve its warnings and forecasts by acquiring technologically advanced systems. Moving these programs under one line item provides for combined review of systems in one section of the budget.

NWS system upgrades next decade include: 1) Automated Surface Observing Systems (ASOS); 2) Next Generation Weather Radar (NEXRAD) with Doppler capability to provide nationwide coverage for timely, accurate detection of severe storms and floods; and, 3) an Advanced Weather Interactive Processing System (AWIPS) to integrate, process and transmit high-volume radar, satellite, upper air and surface observation data. We are continuing development of ASOS, begun in 1981, which will reduce labor-intensive field observation procedures.

The cornerstone of our local warning program is the weather radar. We remain committed to replacing the existing obsolete weather radars with an effective, modern system which will serve the Nation well into the next century. NEXRAD is a joint FAA/DOC/DOD effort to develop an advanced Doppler system. Our FY 1986 budget requests $12.9 million to complete the NEXRAD validation phase. During the validation phase, our two contractors will produce a radar system for evaluation. Because off-the-shelf, commercially-available Doppler radar has improved over the past few years, we will also evaluate systems in FY 1985 to identify the most cost-effective Doppler weather radar system, or mix of systems, that meets the Nation's needs.

In the last few years we have witnessed an exciting series of developments in our ability to forecast small-scale weather phenomena. At the National Severe Storms Forecast Center (NSSFC) we have used a pilot interactive computer-based system which permits forecasters to integrate radar, satellite and other meteorological data when making forecasts. The Program for Regional Observing and Forecasting Services (PROFS) system developed at the Environmental Research Laboratories applies the interactive computer procedures to improve our short range severe weather warnings and alerts.

In order to make the features of this new interactive computer system available to NWS field offices, our FY 86 budget requests $2.5 million to initiate the Advanced Weather Interactive Processing System (AWIPS). The AWIPS system, which will replace the existing AFOS system in the 1990's, will improve the communication and processing of our observational data and forecasting products. AWIPS will increase our ability to provide better warnings and forecasts to the public.

Our FY 86 budget request supports the basic mission of the NWS to provide essential forecasts, warnings and advisories for the protection of life and property and to promote economic development by supplying other government agencies and industry with timely weather and climate services. We propose to decrease or eliminate funding for programs which are no longer necessary, are low priority, or are not Federal responsibilities. We are not proposing any general weather station closings. To reduce overhead, our FY 86 budget requests the consolidation of the Pacific and Alaska Weather Service regional offices and proposes closing the Southern Regional NWS headquarters. These offices provide field managerial support, but have no forecasting or data gathering responsibilities. Staff reductions in the FY 86 budget will result in a more efficient staff structure without detriment to key service delivery. We are seeking to terminate FY 1985 budget add-ons for NOAA Weather Wire and Radio and the Colorado River Basin Flood Warning System.

Providing specialized weather services for specific user groups is not a Federal responsibility. Agricultural, fruit frost and some fire weather services are discontinued in our FY 86 budget. Continued fire weather services for Federal forest lands will be provided by the NWS on a reimbursable basis from the Department of the Interior. General public forecasts will be available to these industries; specialized forecasts should be provided to industry by private sector meteorological firms. Our goal is to devote resources to improving our ability to get fast, accurate weather warnings and alerts to the general public.

## Oceanic and Atmospheric Research

NOAA's Office of Oceanic and Atmospheric Research conducts research and development for other NOAA components and Federal agencies as well as the private sector and atmospheric, marine and space research communities. OAR's research programs range from technology development to improve our ability to predict meteorological and climate conditions to investigations of fundamental physical and chemical properties of the atmosphere, hydrosphere and solar-terrestrial environments.

Our FY 86 budget requests enhancements to accelerate two atmospheric research programs -- the PROFILER ($3.05 million) and the Radiatively Important Trace Species (RITS) program ($200K). Major efforts in both areas began in FY 1985 -- PROFILER at $3 million, RITS at $1.3 million.

OAR's Wave Propagation Laboratory (WPL) is developing a Doppler radar system called PROFILER for remote measurement of wind profiles and precipitation fields within storm systems. In FY 86 we propose to begin procurement and testing of 30 PROFILERS.

The RITS program, which started in FY 85, involves research and monitoring to test a theory that certain trace constituents of gases and aerosols (nitrous oxides, methane, chlorofluorcarbons and tropospheric ozone) contribute to the warming of the earth's atmosphere. This so-called "greenhouse effect" could, in the long term, cause significant global climatic changes affecting rainfall and food production patterns.

We are seeking the same level of funding in FY 86 for NOAA's participation in the National Acid Precipitation Assessment program as in FY 85 ($4.4 million). NOAA is developing techniques to measure dry deposition of acidic materials and the source, extent and transport of wet and dry acidic materials.

NOAA will continue its research on El Nino in FY 86. This El Nino research is carried out by several nations participating in the Tropical Ocean Global Atmosphere (TOGA) program. NOAA is the lead U.S. TOGA participant. A recently developed model has been successful in simulating oceanic conditions in the equatorial Pacific during the 1982-83 El Nino event, and this model will be adapted for operational use in 1986.

Investigation of the ocean's role in climate variability over longer periods is conducted through the Subtropical Atlantic Climate Studies (STACS) program which develops techniques to monitor the processes by which the North Atlantic Ocean transports excess solar heat poleward from equatorial regions. After successfully developing an electromagnetic technique for monitoring the Gulf Stream off Florida, STACS will extend its investigation to the Carribbean Sea and Windward Passage to determine the magnitude of the Florida Current transport and variability.

Our FY 86 budget will allow 24 hour/7 day a week access to NOAA's Space Environment Laboratory Data Acquisition and Display System (SELDADS) which provides solar-terrestrial data for government, industry and foreign governments. This information is vital for communications as well as air and space travel which can be disrupted by magnetic storms or solar flares.

In FY 1986, NOAA plans a Fisheries Oceanography Coordinated Investigations (FOCI) initiative to acquire the information needed to understand and predict the effects of environmental variability on major U.S. fishery resources. This is a multidisciplinary research effort which is being conducted initially on a large mass of pollack recently discovered in the Shelikoff Strait, Alaska.

One objective of NOAA's research on marine warning and forecasting is to develop advance forecasts of sea ice as an aid to fisheries and navigation. In cooperation with the Office of Naval Research, NASA and the Coast Guard, NOAA has completed a study of sea ice drift and ice edge behavior in the Bering Sea and will begin work in the Beaufort Sea in FY 86.

Decreases are being proposed for low priority research programs or for programs which have accomplished their goals. We can now reduce the PROFS program (mentioned earlier in my testimony) by $2 million. PROFS has been an experimental program. Its results will be applied to the operational field system (AWIPS), which we are developing. The Global Atmospheric Research Program (GARP) will be reduced by $1 million. The First GARP Global Experiment (FGGE) data set was collected in 1979, and we have been studying this data for five years. We can now phase down concentrated data analysis. We will continue research on long- and short-term climate forecasting based on FGGE data. We plan to eliminate the Weather Modification Grants Program ($2.65 million). This program's results have been inconclusive and these grants to states are not a Federal responsibility. We will terminate funding for the one-time FY 1985 add-on for research on Mesoscale Convective Systems ($2.5 million).

## National Environmental Satellite, Data and Information Service

The National Environmental Satellite, Data and Information Service budget items of interest to the Subcommittee include the procurement and operation of the polar and geostationary weather satellites, and the collection, archiving and dissemination of environmental data and information.

In FY 86 we are seeking increased funding of approximately $59 million. Most of this increase ($55.58 million) will allow us to continue the procurement for GOES I, J and K which began in FY 1984 and add the procurement of two additional satellites and launches. In addition, the GOES NEXT program will significantly improve the satellites to monitor severe storms and hurricanes through improvements in the soundings and imaging resolutions. These actions will put the GOES program on a sound operational basis while reducing the cost per spacecraft.

We are proposing two increases and one decrease in our FY 86 budget for GOES ground systems. In order to prepare for the initial transition of ground equipment and facilities to the GOES-NEXT (GOES I-M) satellite series, obsolete computer equipment must be replaced to allow for system expansion ($2.7 million). An increase ($3.9 million) is requested to upgrade the Data Collection System (DCS) to meet additional user needs. We are requesting a decrease ($683,000) for a program started in FY 83 to replace and modify system components and for a program started in FY 85 to augment the GOES ground system capability. Thisdecrease is requested due to reduced program requirements.

In FY 1986 a joint NOAA/DOD study will be initiated ($1 million) to determine our joint requirements for environmental earth-observing satellites and how to better coordinate the use of our polar orbiting systems. We seek a FY 86 decrease ($10.96 million) to move to a one polar configuration. The search and rescue system capability will be continued.

Funding for Data and Information Services -- global data and information for commerce, industry, agriculture, science and engineering, the general public and all levels of government -- will continue at the FY 1985 level.

Mr. Chairman, I will answer any questions you or the other Members of the Subcommittee may have regarding NOAA's FY 1986 budget.

Mr. McCurdy. Thank you, Dr. Calio, for your statement, very through statement. I have a series of questions and then I'll turn it over to my colleagues, but in the outset I want to make a statement to—more importantly to the record, but for Dr. Calio, who I think knows my position—but to raise an area of concern. I count myself as one of NOAA's strongest supporters among the members of the House and I'm encouraged when NOAA's Research Programs give the folks back home a tangible benefit for their Federal tax dollars. One such example is the upgrading of the weather systems used to detect severe storms across the country. Severe weather is of great interest to me since my District, in Oklahoma, sits in what is known as "Tornado Alley". Any work by the weather service that helps protect the public against tornados, storms and flash floods is certainly most welcome. In fact good weather detection should be of interest to every area of the country, since any thunderstorm can produce a tornado similar to the dozens unleashed across the Midwest last June.

A key part of NOAA's effort to upgrade weather systems is the Next Generation Weather Radar System, known as NEXRAD. NEXRAD Doppler radar will render the 25-year-old units now in use totally obsolete. The NEXRAD nationwide system will make it possible to warn the public 20 to 30 minutes before a storm strikes. NEXRAD will help warn military and civilian aircraft of microbursts and wind sheers. NEXRAD will be useful for water management and flash flood control or predictions.

Weather experts in my State tell me that NEXRAD can save our country from $90 to $360 million a year in property damage, not to mention the hundreds of lives saved because the public had time to take cover. Despite these and many other benefits to be derived from modernization, the NOAA budget submitted would postpone work on NEXRAD. In fiscal year 1986 NEXRAD funding is reduced dramatically. OMB would cut off plans to build a NEXRAD prototype so that NEXRAD can be compared with off-the-shelf Doppler radar.

Depending on the results NOAA will proceed with NEXRAD or buy these off-the-shelf models. I personally believe we cannot afford this delay. It simply is not in the best interest of the people that NOAA seeks to protect. Postponement does not save lives or property. Postponement costs the program $60 to $80 million a year and why, after years of developing a program that meets DOD, FAA and NOAA specifications would we want to switch to a system that has shown it cannot match NEXRAD's science. Mr. Chairman, and since I'm sitting in for the chairman, for the record, I have a point-by-point comparison of the performance of NEXRAD with alternative systems that I would like included in the record. (See appendix.)

The NOAA disaster study team that surveyed the Carolinas after the tornados killed 57 people there last March, urged earliest possible NEXRAD installation. A report by the Public Works and Transportation Committee last November said that NEXRAD, "is a sorely needed advance in weather observation technology" for aviation safety. Mark Twain once lamented that everyone seems to talk about weather but nobody does anything about it. Well, I think that NOAA attempts to do something about it, but I'm not sure that OMB shares that same philosophy. I appreciate the comments that you've made, Dr. Calio, but I am particularly concerned about the cut in NEXRAD of $7 million from the 1985 levels and $17 million from the original program plans for this system.

Now, my first question is: You've mentioned off the shelf technology as a replacement for NEXRAD. Would you please describe the alternatives NOAA is considering for improving the weather radar and does this option contemplate the same Doppler coverage nationwide?

Dr. CALIO. OK, as you—first of all let me express my agreement with your feeling about NEXRAD being the backbone to a new and advanced capability for the Weather Service. We, collectively, in NOAA agree with that and the NEXRAD, along with the other technological developments, profiles and the like, are very important steps that we must take to increase capability of the Weather Service.

When we look at the total program for NEXRAD what we have done, essentially, is to provide an evaluation of a validation and test period in the 1986 timeframe. That is still along the lines of the basic plan. When we look to the production and the procurement of NEXRAD's systems we are talking about an expenditure for the country of about $500 to $600 million and we think it is important, at this point in time, while we're going through the validation test phase, to be able to see if there are any off-the-shelf technology that could be used that can be considered that will meet the requirements as set forth for NEXRAD and provide that capability at a lower cost to the taxpayer. That is the notion. I still feel that we can come forward in 1987 with a production buy, in fiscal year 1987 budget for a production buy and the maximum that I see it delaying the program is approximately 6 months.

Mr. McCURDY. What are the off-the-shelf technologies?

Dr. CALIO. Well, one of them would be the use of an Enterprise system, which is a radar system which we currently have in the field in two locations for the Weather Service. The question is can these existing radar systems be upgraded and modified in such a way that we meet the requirements that we've set forth for NEXRAD and at the same time provide us that capability at a much lower cost.

Mr. McCURDY. Do they currently meet the NOAA specifications?

Dr. CALIO. The existing ones in the field? To the best of my knowledge, the ones that are existing in the field, no. But, the question is, can a minor upgrade of that capability take place, with existing technology, that would indeed meet the specifications and that's something that we're—that is really up to the validation phase. As you know we are having AFOTEC from the Air Force do the validation test. We would agree to what those test procedures are beforehand. And AFOTEC then would carry out those validation tests and give us the engineering answers as to whether any of these systems or which of these systems meet the requirements as set forward.

Mr. McCURDY. Do you foresee a lessening or reduction of the specs for this program, specifications?

Dr. CALIO. No, we are doing another parallel study where we're evaluating the specifications or performance, or we hope to evaluate performance, as a function of cost. And so that we'll see at some point in this coming year if reducing the specs would indeed change any of the costs that could be incurred in the acquisition of these systems. But, the current—currently we would not anticipate changing those specifications.

Mr. MCCURDY. Since NEXRAD is an interagency effort involving DOD, FAA, and NOAA, have—has NOAA revised its plans for NEXRAD or have the revised plans been coordinated with the other agencies? And what's been their reaction?

Dr. CALIO. To the best of my knowledge they have been coordinated. I would say generally they're displeased with the loss in time that you've indicated that is important.

Mr. MCCURDY. Displeased?

Dr. CALIO. Pardon me?

Mr. MCCURDY. You said displeased?

Dr. CALIO. Displeased, yes, with the possible loss of time, but they also have to consider that we may be able to end up with a system that will meet the specifications at a lower cost to the taxpayers.

Mr. MCCURDY. Have they changed their—have they changed their budgets to reflect the changes that you've discussed? That you're aware of?

Dr. CALIO. I believe they have, but let me check. I'm advised that the FAA has, but we do not know whether the Department of Defense has.

Mr. MCCURDY. OK. NEXRAD has capability other than predicting severe storms, could you specifically address the hydrological and water management aspects of NEXRAD or you may want to refer to some of your science folks behind you.

Dr. CALIO. May I do that. This is Dr. Friday, Deputy Director of the National Weather Service.

Dr. FRIDAY. Yes, sir. The NEXRAD Program is designed with the capability in mind of satisfying not only the meteorological severe storm side of our business on one end of the scale, but also providing a very thorough, complete hydrological data base for us. It is designed with software requirements that will permit it to map the total accumulation of rainfall occurring over the entire area of NEXRAD coverage, basically providing an integrated rainfall charts and rainfall accumulation over the entire United States, for input both into the flash flood and river flood warning programs of the National Weather Service, as well as serving basic input for the overall requirements for the water resource management now and in the future.

Mr. MCCURDY. Dr. Calio, and I'm going to recognize the other members, but I want to make a point here and I want to get it clear in my mind first. As I address this I think I'll make it clear that I perceive in my understanding of this change it is basically coming—is directed by OMB, but it's my understanding, and correct me if I'm wrong, that OMB originally proposed in the 1986 budget that the NEXRAD Program be scrapped and that the Weather Service install off-the-shelf Enterprise radars beginning in 1986. If that is not true, I'd appreciate it if you would correct that. But, if it is true I'm very much concerned about the question of sole-source procurement. I have a question about Federal procurement regulations. I'm concerned about the effect of—it is my belief that competition is good for the country and that with the two contracts or the contractors that have been competing on this system for some time, that there was a lot of competition there that was going to be beneficial in the development of this program. Am I misled as to these conclusions? (See appendix for OMB "passback" to the Department of Commerce in fiscal year 1986 re NEXRAD.)

Dr. CALIO. Well, I'll make a couple of statements there. I stated that not only OMB has other thoughts about NEXRAD, but there are some members of NOAA, as well. It was not OMB's position to scrap NEXRAD, as I recall and if I say the wrong thing I'll get corrected here in a minute. OMB's concern was the mix of radar systems in the field. Did we need all of the 10 centimeter NEXRAD radars in the field or could we have some other mix and still provide the necessary coverage for the Nation that would satisfy the requirements. Let me correct—let me see if that's correct. OK, so it was a question of mix. The money was left in and the question was still up as to what will ultimately be purchased. Will it be all the NEXRAD, as we say, development program or would it be a combination of NEXRAD's with other radar systems.

Mr. MCCURDY. I want to make it clear to my colleagues that I don't have a particular ax to grind here. I don't have a contractor in my district that's in this—or involved. I do have a first-class meteorological school that is extremely interested in the National Severe Storm Laboratory, which is normal, is concerned about the science and that we are addressing the technology and that we are moving as quickly as possible to get to the leading edge of technology, which they feel is achievable within the current specifications that NOAA has been discussing and that they, from a science standpoint, are extremely concerned about OMB now coming in and trying to change the rules and if it's NOAA that has some of that concern then I'll make the statement to NOAA too, that there are some of us on this committee and in Congress that are concerned about protecting the science and we're going to do everything that we can to make sure that it is protected.

I recognize my colleague from Colorado, Mr. Wirth, if he has questions.

Mr. WIRTH. Thank you, Mr. Chairman. If you don't have a contractor in your district I would suggest one move there they would find a very good advocate for what they're doing.

Mr. MCCURDY. We may suggest that later too.

Mr. WIRTH. Tell me, Dr. Calio, is NOAA still carrying out pork-barrel and poor quality research?

Dr. CALIO. I don't think NOAA carries out poor quality research.

Mr. WIRTH. You don't agree with Dr. Keyworth's statement then?

Dr. CALIO. I'm not—I'm familiar with Dr. Keyworth's statement. I've never had a detailed discussion with Dr. Keyworth about what he meant by those statements.

Mr. WIRTH. You haven't. You haven't defended the Agency that you want to head up to the President's science adviser?

Dr. **Calio**. I've had general discussions with him, but we've never been able to get down to the details of what he meant by those statements.

Mr. **Wirth**. Well, could you—do you think you could submit to the committee what that conversation might be, so we'd know what Dr.—we wrote to him and asked him what he meant. We didn't get any answer and a lot of people have. Or do you think he just made a mistake?

Dr. **Calio**. To the best of my understanding of that situation I thought it had to do with some questions and answers that took place after he made his statement, after he had given a talk and——

Mr. **Wirth**. But, you don't agree with that?

Dr. **Calio**. With his statement?

Mr. **Wirth**. Yes.

Dr. **Calio**. No, sir.

Mr. **Wirth**. OK, good. That's an appropriate answer to give, isn't it?

Dr. **Calio**. What else can I say. (See appendix for Keyworth responses to questions re NOAA.)

Mr. **Wirth**. Tell me about—let's talk a little bit about following up on Mr. McCurdy's questions on budget numbers. If you take a program like the SEL Program of the Office of Atmospheric Research, can you do a pretty good economic analysis that says that the research done on that is cost-effective—is that how you—can you do that and make a decision about those programs as a consequence?

Dr. **Calio**. Not very well, because you're talking about the effect—the contributions to operational forecasting capability. Are we studying the right things to be able to understand the——

Mr. **Wirth**. Let's stay in SEL and the disruption of communications. I mean there was a lot of discussion about that, last year and the year before, that there were very real economic benefits that came out of what the Federal Government was doing.

Dr. **Calio**. I'm happy to say, sir, that we are recommending in the fiscal year 1986 budget that we follow your lead and keep the operations going for 24 hours, 7 days a week.

Mr. **Wirth**. I have noticed that with some gratitude. There is a million and a half dollars less in there than would be otherwise though, right?

Dr. **Calio**. That's correct.

Mr. **Wirth**. Why is that?

Dr. **Calio**. The research part of it, sir. It's a question of priorities and a question of priorities in the atmospheric arena. As I mentioned earlier we feel that one of the backbones to our future forecasting capability is to do the NEXRAD, is to do the development for the AWIPS, is to develop the PROFILERS and put those in the field.

Mr. **Wirth**. So the research at SEL is not a high priority?

Dr. **Calio**. It ends up as a lower priority sir, that's correct.

Mr. **Wirth**. Is the Office of Atmospheric Research a high priority?

Dr. **Calio**. The Office of Atmospheric Research is an important element, yes, it's a high priority. We have to consider research activities. We cannot just do the operational or the development activity without considering future research needs.

Mr. WIRTH. Well, is it true that the National Academy said that severe storms research should be the No. 1 priority? Did they say that?

Dr. CALIO. I guess that's a question of medium scale research, I guess is the thing you're driving at, if I remember the three elements that they talk about having or conducting research in the three areas.

Mr. WIRTH. In the Atmospheric Science, the severe storm research, the National Academy said——

Dr. CALIO. It should be the No. 1 priority, that was where we get the biggest return and two other elements are also important, climatology and the atmospheric chemistry, they're all No. 1.

Mr. WIRTH. All of which suggests if all of these are important we get right back to where you all have been with this Committee and with the Congress for some time. That there are continuing efforts, SEL research cut a million and a half bucks, the severe storm research cut $2.5 million, the Office of Atmospheric Research is cut as well and yet they're all priorities that Congress comes back to you and says, "now wait a minute. We think this basic research is a good idea." You know the net—compared to the overall level of funding for research and development across the budget, NOAA does not fare very well in terms of research. The Committee always comes back and says, "hey, you know, we think it's important to put that money back in again." Why is it that the Congress, Republicans, and Democrats are both saying, "let's fund research and development," and you all come up here year after year after year and say, "no, we shouldn't do that." Why?

Dr. CALIO. Well, I think it's a question——

Mr. WIRTH. Both sides of the aisle up here, conservatives, liberals, Republicans, Democrats are all saying, "research and development is very important. This research is something we ought to be doing."

Dr. CALIO. And I think we're contributing to the——

Mr. WIRTH. Demise.

Dr. CALIO. Pardon me?

Mr. WIRTH. Well, why do you always come up here and say, "take money away" and the Congress always comes back and say, "no, this is a terribly important area." Even some of our more conservative brethren are saying that.

Dr. CALIO. I understand that, but one of the things that you have to consider in the meso scale of the medium scale research is that the $6 million we have in this year's budget for the PROFILER contributes significantly to that understanding because we must collect the data, must monitor the atmospheric conditions to be able to give a background of data to those researchers for the future. I think, in the coming years, after we have this monitoring capability in place with such devices like the PROFILER, we should then begin a stronger effort and increase the funding for this kind of research.

Mr. WIRTH. Mr. Chairman, can we leave the record open. I have a lot of specific questions I'd like to ask Dr. Calio, and I don't want—and there are a lot of very, very specific programs in which

I think the Congress, year after year after year, again has come back to you and said, "we don't think that the priorities you all are setting are the appropriate ones", and I would like to be able to get that, if I could.

Mr. McCURDY. Without objection.

Mr. WIRTH. I just have one final question related to, you were talking about young researchers. What's going on in terms of the recruiting of people at NOAA or the retention of people in the middle levels?

Dr. CALIO. Well, across the Government, if you're referring to the 11 to 15——

Mr. WIRTH. Yes.

Dr. CALIO [continuing]. Slots.

Mr. WIRTH. Yes.

Dr. CALIO. Across the Government we are all exercising reduction in the number from the 11—of individuals in the 11 to 15 grade categories. I think that's not going to have an effect on the people who are interested in doing this kind of work. Nor will it have an effect on the career progress for those people who indeed contribute significantly.

Mr. WIRTH. Is an 11 to 15 grade bulge for NOAA just as important as an 11 to 15 grade bulge at Social Security or at the VA? Is it all the same?

Dr. CALIO. The budget deficits arise from Federal spending from across the board.

Mr. WIRTH. No, that's not the——

Dr. CALIO. But the point is that we have——

Mr. WIRTH. Is the impact the same at NOAA as it is at Social Security and at say, the Veterans' Administration?

Dr. CALIO. That's hard for me to tell from Social Security and the Veterans' Administration, what the impact is as far as the grade bulge in those——

Mr. WIRTH. Well, you know as well as I do that the argument is made that in an agency like NOAA, at a scientific agency, or an NIH has a similar kind of a problem, you have a grade bulge there because in those grades you attract the kind of high-level scientific talent that presumably you want to have, both to manage and to carry out the research functions that the Federal Government does.

Dr. CALIO. That's correct.

Mr. WIRTH. Therefore, one argues that to say a grade bulge is the same in one place as it is in another where the argument from the other place is that you have a grade bulge unnecessarily for administrative agencies—that's not true of scientific agencies. Maybe we could leave the record open and you could try a response to that again——

Dr. CALIO. OK.

Mr. WIRTH. Because I think that there really is a very significant difference when you're trying to recruit and retain people at a scientific level to carry out again, what I think most people up here agree is a pretty high priority, which is basic—conducting basic research and managing that basic research and that takes a lot of people who are in the GS-11 to 15, you're going to tend to have more of those in an agency like NOAA. If you could go back and give that another shot. I appreciate what you're doing with SEL too, I would tell you that.

Dr. **Calio**. Thank you, sir.

Mr. **Wirth**. Not enough, but you're headed in the right direction. Thank you, Dr. Calio. Thank you, Mr. Chairman.

Mr. **McCurdy**. Mr. Henry, do you have questions?

Mr. **Henry**. Well, thank you, Mr. Chairman. I wonder if Dr. Calio would just give us a brief review of the apparently concluded work of the Great Lakes Environmental Research Laboratories. Maybe you'd review some of the charges of that effort and tell us why you've concluded that apparently it's no longer necessary. I was under the impression that the future of the Great Lakes waterways continues to have some National import and I note that in your prepared remarks it didn't even rate the designation of low priority. It was nonpriority, it just kind of disappeared, as it does in the budget.

Dr. **Calio**. Well, the notion, the concept here again is priorities. Again, it's a question of is there still a Federal presence in the Great Lakes region and as you well know the EPA is still there operating its program and its water quality program and the Department of the Interior is still there with its Great Lakes Fisheries Program. We're still maintaining the relationship with Canada in water quality agreements and we're still maintaining the agreements as far as fishery laboratory support is concerned through the Department of the Interior. The Federal Government is still putting $8 million in the Great Lakes activities and at that point it was felt that we were able to withdraw our activities from the Great Lakes.

Mr. **Henry**. Was there nothing you were doing that was worthy of support? Or what exactly have you done that was justifiable? I mean you're suggesting it wasn't necessary to begin with.

Dr. **Calio**. No; I'm not suggesting that, sir, as a matter of fact we did suggest that the Great Lakes laboratory remain open.

Mr. **Henry**. Why did you suggest that it remain open?

Dr. **Calio**. Because we did think that it does make a contribution to the welfare of the Great Lakes. But again, in the question of priorities and the question of reducing Federal funding, the final decision was to close the laboratory.

Mr. **Henry**. So, your request to OMB was that it remain open?

Dr. **Calio**. On that first round, that's correct, sir.

Mr. **Henry**. It was OMB's——

Dr. **Calio**. And the Department also went forward with that recommendation.

Mr. **Henry**. OK, what will we lose with the closing of that laboratory and program? It's really not just one lab, but——

Dr. **Calio**. I think a lot of the basic pollution research work that has been done in the Great Lakes over the past few years, primarily, I think that's the main loss in the area. The—along that line, from the standpoint of pollution work, a model, as you know, was developed for the uptake of contaminants for Great Lakes fish. A study was completed on the benthic invertebrates and the reduction of phosphorus and the most important nutrient contributions to the eutrophication of the Great Lakes. A 1-year field study that used satellite tracking current drifters to verify and improve the method to forecast the movement of oil and hazardous substances in the Great Lakes and the development of a large basin runoff model that uses analytical formulations of chronological parameters relevant to large watersheds.

Mr. **Henry**. Thank you. Particularly, that last item, more than anything else, your agency plays a very critical role in our State and for the whole mid-Western region as increasingly people are talking about just literally draining off the Great Lakes as exported water supply. EPA doesn't get involved in that at all, it does deal with some of the other health related issues and I'll certainly, for one, want to be following this as the committee proceeds. Thank you.

Dr. **Calio**. Yes, sir.

Mr. **Scheuer**. Mr. Calio, did I understand you to say that the EPA would continue its presence up there?

Dr. **Calio**. Yes, sir.

Mr. **Scheuer**. It's my understanding that the EPA plans to close down their facility in the Great Lakes.

Dr. **Calio**. The fiscal year 1986 budget submission for EPA, to my understanding, is about $5.1 million.

Mr. **Scheuer**. A very large cut from what has been funded up to now. Do you think they're going to be able—with that cut—they're going to be able to continue what they've been doing, plus pick up the load that NOAA's been doing?

Dr. **Calio**. No.

Mr. **Scheuer**. Why don't you tell us what's going to be lost in the shuffle? What functions are going to fall by the wayside?

Dr. **Calio**. I don't know what the EPA reductions are. I've just highlighted for Mr. Henry what the reductions would be as far as NOAA is concerned in the Great Lakes.

Mr. **Scheuer**. Well, maybe you could confer with NOAA—with EPA, your EPA colleagues and get back to us and tell us, between the two of you, what the net reduction in functions in the Great Lakes area is going to be between NOAA and the EPA. I think that's what we're looking for.

Dr. **Calio**. All right. We can provide that for you in writing.

Mr. **Scheuer**. If you're able to pick up the slack, you know, well and good, fine and dandy. If you're not I think we have to know about that.

Dr. **Calio**. We'll do that for the record, yes sir.

[The information follows:]

The FY 86 budget request for Great Lakes activities by the Environmental Protection Agency is approximately $5.6 million overall.

NOAA's research in the Great Lakes has included toxic contaminants and nutrient over-enrichment which impact water quality; food chain interactions; lake levels which impact navigation and shoreline property; the hydrologic cycle and river flows; and, ice formation and movement which affect shipping.

EPA's research program in the Great Lakes is primarily directed toward the regulatory mission of the Agency and the Clean Water Act. EPA's wastewater treatment construction program has improved significantly the condition of the Great Lakes. The EPA is shifting the focus of its Great Lakes National Program Office to quantifying the magnitude of toxins from various sources, including pesticide runoff from nonpoint sources, groundwater contamination and in-place polluted sediments.

It should also be noted that the Department of the Interior has a fish laboratory monitoring toxin levels in the Great Lakes fish population. The DOI facility is recommended for funding in FY 86 at a level of $2.9 million. The U.S. Department of

Agriculture conducts basic and applied research on agricultural lands which drain into the lakes, and the Corps of Engineers conducts mission-oriented research to support the operations of the North Central Corps Division and its Districts. The Corps has conducted considerable research on extended season navigation in the Great Lakes area.

We are recommending the phase-out of NOAA's Great Lakes Environmental Research Laboratory in FY 86, but as I have outlined, we are not the only Federal presence in the Great Lakes and among EPA, DOI, USDA and the Corps, in conjunction with the States, the research needs of the Great Lakes should be met adequately.

Mr. SCHEUER. OK, now the fiscal 1986 budget states that, "there is no degradation in quality of weather forecast from operating a one polar system instead of a two polar system." Are you familiar with that quote?

Dr. CALIO. Yes, sir.

Mr. SCHEUER. Do you believe that?

Dr. CALIO. Yes, sir.

Mr. SCHEUER. What are the advantages of a two polar system?

Dr. CALIO. Insurance. Risk assessment. It's a question of if we lose that one polar orbiting satellite it would take us 120 days to replace it with a second one.

Mr. SCHEUER. At the very minimum. We've had estimates of anywhere from 120 days to 1 year; 18 months.

Dr. CALIO. Well, I don't think it would be 18 months, sir.

Mr. SCHEUER. Do you have any idea what the impact on our military would be if we lose that one polar orbiter?

Dr. CALIO. Currently? None.

Mr. SCHEUER. No; that's not true.

Dr. CALIO. The military have their own——

Mr. SCHEUER. In the late seventies and in the early eighties and the times and the dates are classified, so I won't go into any further detail on that, the military weather satellite program suffered some system failures and they depended heavily on the backup—on the backup capability of the NOAA polar weather satellites. Now, do you want to take a risk just to our military, the integrity of our military satellite services that they're going to be without these satellite services if there isn't a NOAA backup for anywhere from 3 months to 1 year?

Dr. CALIO. May I explain my answer, sir?

Mr. SCHEUER. Please do.

Dr. CALIO. Currently, no. And I agree with your statement that during that time period the military did depend on the civil systems. But, at the present time the military has two operational meteorological satellites and do not require for their security purposes, the collection of data from the civil systems.

Mr. SCHEUER. Why do they have two? Why isn't one sufficient?

Dr. CALIO. I believe there are two for—I think those are for classified reasons, the purposes of those two machines serve different needs within the military. It does not apply the same way that we have the second satellite for providing a backup to the primary satellite.

Mr. SCHEUER. You don't think the backup reason is sufficient reason?

Dr. CALIO. Excuse me, sir; my advisors tell me that I did answer that properly. That there is an entirely different reason why they have two satellites as opposed to why we have two.

Mr. SCHEUER. Well, they would have suffered grievously in the late seventies and early eighties if they hadn't had the NOAA backup. Now, they may——

Dr. CALIO. I agree with that statement, sir. You're absolutely right.

Mr. SCHEUER. And they may have provided their own backup since. They may not want to be in the position of relying on a—on the shaky reed that the NOAA system has become. Let's just go over some of the advantages of having the two polar satellite system, versus a one polar system. Backup capability, OK, reducing risk of interruptions, insurance against data gaps, increased data acquisition leading to better forecasts, would you go along with that?

Dr. CALIO. No, sir.

Mr. SCHEUER. You wouldn't go along with that?

Dr. CALIO. No, sir; I have probed that in great depth from the National Meteorological Center and they have not been able to quantify for me the benefits or the losses of that second satellite.

Mr. SCHEUER. Haven't the NASA studies indicated significant differences in weather forecasting accuracy when data from two satellites are used?

Dr. CALIO. Perceptible. I'll have to ask about that.

Mr. SCHEUER. I tell you, if your folks—if you don't have access to that information we have enough information in our files, I think, to convince you and we'd be happy to share it with you.

Dr. CALIO. Well, I feel——

Mr. SCHEUER [continuing]. And we will share it with you. We will keep the record open at this point and will ask you to respond to this question.

Dr. CALIO. OK, because I really have penetrated this in great depth before, I would take the position that I'm currently taking.

Mr. SCHEUER. How about the advantage of the increased backup for geostationary satellite systems?

Dr. CALIO. How do you mean that, sir? Excuse me, I didn't follow your question.

Mr. SCHEUER. How about the advantage of having an increased backup for our Geostationary Satellite System?

Dr. CALIO. Well, the data products coming—you mean using polar orbiting data to replace geostationary orbiting data?

Mr. SCHEUER. Yes.

Dr. CALIO. The products and the use of the data are entirely separate. Certainly, if we didn't have any geostationary capability they would provide some information. I don't know how that would be integrated into the forecast models that are on line.

Mr. SCHEUER. We understand that we're close to losing our geostationary satellite?

Dr. CALIO. Well, we're down to one, that's correct.

Mr. SCHEUER. And we're close to losing it?

Dr. CALIO. Well, I don't know if we're close to losing it. We're down to one.

Mr. **Scheuer**. How about the reinforcement it gives our search and satellite—our search and rescue coverage, where we saved over 300 American lives, mostly due to the fact that the Russians are out there with their satellite and cooperating with us.

Dr. **Calio**. I understand that and that we will be able to fly with the launch of the next NOAA satellite. We will have two search and rescue processors flying simultaneously through the 1990 time period.

Mr. **Scheuer**. Whose two?

Dr. **Calio**. Our two. We will have two flying.

Mr. **Scheuer**. I don't quite understand.

Dr. **Calio**. We plan to launch another polar orbiter this year. We have one already that's been launched that has a search and rescue processor or board. We anticipate those processors, both of them, lasting through the rest of this—through the rest of the 1980's.

Mr. **Scheuer**. Now, with your single satellite, with your single polar orbiting satellite when you have 120 nations relying for their daily life and death decisions on what to plant, when to plant it, when to harvest it, when to irrigate, when to fertilize, what would happen to those 120 nations if that single polar orbiting satellite were to go on the fritz.

Dr. **Calio**. If we lose the one we have 120 day to 160 or 80 day reduction in capability.

Mr. **Scheuer**. Or 365 days maybe?

Dr. **Calio**. Well, I don't think we'd go that far, but——

Mr. **Scheuer**. Nobody does, do they?

Dr. **Calio** [continuing]. That's a judgment call.

Mr. **Scheuer**. We've been told 3 months to a year. And what are we going to tell those 120 nations that are relying on us to get the essential information they need to avoid the kind of famine you're looking at right now in Africa. What are we going to tell them?

Dr. **Calio**. Well, as a matter of fact I think our head of the satellite service has been trying to work with the other nations to see if we can get international support for such a satellite for the future. And if they have the interest and the inclination to do that we might be able to put such a program together. And reduce the cost to the American taxpayers.

Mr. **Scheuer**. Right now they're relying on us.

Dr. **Calio**. That's correct, sir.

Mr. **Scheuer**. And that's one thing that we can give them as a by-product of the use of the satellite for our own purposes, both civilian and military, that we sort of get a freebee. The second polar orbiting satellite would not be exclusively for their benefit, it would be for our benefit. It would enhance the integrity and continuity of our own services, but an additional payoff would be that it would assure the continuity of the information we give them.

I've got a role call vote coming up. Why don't we recess this meeting for about 15 minutes to give the members a chance to vote.

Dr. **Calio**. Yes, sir.

Mr. **Scheuer**. We'll see you back here in about 15 minutes.

Dr. **Calio**. Thank you.

[Recess taken.]

Mr. McCurdy. Mr. Chairman, if I might I have couple of questions I'd like to ask the witness as far as Landsat and a couple of other programs and for the record I think other members may be returning from the vote.

Dr. Calio, the effort to transfer land remote sensing satellites to the private sector has, in my opinion again, been stymied by OMB's refusal to release enough funds to permit the EOSAT Corp., the winning bidder to begin construction and marketing operations. Can you tell me what the status of the negotiations involving EOSAT, OMB and the Source Evaluation Board of the Department of Commerce is? What is the current status?

Dr. Calio. We are still in negotiations, Mr. Chairman. The—as you recall as we submitted the President's budget request here to Congress we had stipulations or conditions as to what had to be the requirement to be filled by EOSAT. EOSAT has been responsive in looking at those requirements, maybe $250 million, two satellites, 6 years operation per launch and manufacturing and they have submitted a response to us. We have discussed it internally within the Department and we are currently discussing the situation with OMB and are negotiating out the response, hopefully again, and I keep saying this, within the next week or so, we should have an understanding as to whether we will proceed or not.

Mr. McCurdy. What would be the—if you reach an agreement and you proceed, what is the process at that point?

Dr. Calio. That we would sign an agreement with EOSAT. We would then make a request to the Congress for an 1985 supplemental and for an 1986 amendment and would try to begin the transfer as early as possible with EOSAT. We would probably initiate the activity considering a reprogramming action internally, realizing that supplemental may take some time to get the congressional approval.

Mr. McCurdy. Without getting into the areas of negotiations and I'm sure you'll tell me if we are, what sums are we talking about in the 1985 supplemental?

Dr. Calio. I think they were actually submitted for the record, Mr. Chairman, $75 million for fiscal year 1985 and about $90 million for fiscal year 1986.

Mr. McCurdy. All right. And the total being $250 or in that neighborhood?

Dr. Calio. Thereabouts, yes sir.

Mr. McCurdy. All right. Is it not true that the delays, if we go beyond the next few weeks in the negotiations, are in effect compromising EOSAT's ultimate ability to compete with the French and the Japanese in this new commercial field and is it not true that the French and Japanese are aggressively working to develop a market in this area?

Dr. Calio. The French for sure. I believe their launch is anticipated to be around October of 1985, so your statement is correct with respect to the French. To the best of my knowledge the Japanese are also pursuing the possibility of an Earth remote sensing satellite system a little later in the decade however, not as close upon us as the SPOT [system] is.

Mr. McCurdy. This is probably more a statement than a question, but considering we spent nearly $2 billion in developing

LANDSAT over a period of years it doesn't make much sense to me to throw away that kind of investment by delaying this in order—and allowing the French or the Japanese to take advantage on what we consider $10's of millions of dollars, so for very little—I'll rephrase that. For not as substantial a sum of money compared to the overall investment we're in danger of losing that investment or the advantages of that to competitors. I wanted to make that clear that some of us are concerned again by the delays that it might be—I hope that we don't delay unnecessarily and I hope that we send a message to OMB that we need to proceed quickly because it is an area of interest and I think a valuable investment.

Dr. CALIO. May I add one thing. I do agree with you, Mr. Chairman. The Department is working vigorously with OMB. I also understand OMB's point of view, that is a considerable amount of money, and I think they have to weigh the merits of a future of an Earth remote sensing system and the market potential for industry to be able to develop a new capability in that area.

Mr. MCCURDY. Is it your impression that OMB's primary concern is the marketability or is it the cost to the Government or do they believe this is something that is just not a—commercially feasible system in the future?

Dr. CALIO. It's hard for me to understand which of those three, if all play a part in the decisionmaking as far as OMB is concerned.

Mr. MCCURDY. Do you share those concerns?

Dr. CALIO. Some. I share your view as far as the importance of a land remote sensing system for the United States.

Mr. MCCURDY. Do you believe it is commercially feasible in the future? What are the problems that you foresee in that area?

Dr. CALIO. The risk. The long horizon before we can see a true upturn in the market, either in data quantity or data price. The ability to recover the costs, I think is a big uncertainty. We could take the front end hardware risk out by the Federal subsidy, but we're really going to have to depend, on the latter part of this decade, if we proceed, on that potential market being there. I think that's the big unknown by all parties concerned, EOSAT, ourselves and OMB.

Mr. MCCURDY. What is the alternative?

Dr. CALIO. The market isn't there, then you ask the question, "should we put taxpayer's money into supporting something that has no economic value per se," and I have to say that very advisedly, because if it had an economic value——

Mr. MCCURDY. We're saying the economic value or financial value, business value?

Dr. CALIO. Business value. Business value.

Mr. MCCURDY. I'm curious about, kind of switching topics on you, Secretary of Commerce Baldridge has proposed reorganizing his department into a new Department of International Trade and Industry. Part of this proposal would involve spinning NOAA out of the Department of Commerce as an independent agency, like NASA or EPA. What is the status of Secretary Baldridge's proposal?

Dr. CALIO. That's currently being reviewed by the President. I believe that within the next week or so a decision will be made as to whether we will proceed with that proposal or not.

Mr. MCCURDY. Do you have—are you laying odds on the——

Dr. Calio. Not in this arena.

Mr. McCurdy. The—do you know what caused the demise of this proposal in the 98th Congress?

Dr. Calio. No, I do not.

Mr. McCurdy. I'm not sure I do either, but I knew it was up. Would you support or do you think NOAA should be an independent agency?

Dr. Calio. If the administration decides to go forward with the Department for International Trade and Industry and the decision is to make NOAA an independent agency I would do everything in my power to make that work. If the decision is to keep it as a part of Department of Commerce, I would continue to support the Department of Commerce. I feel there are pluses and minuses on both sides and once a decision is made we would do whatever we should do to make that decision work.

Mr. McCurdy. Well, NOAA has been somewhat like an, I'll rephrase the terms, maybe an "orphan child" but it's one that has been running around for some time with maybe not a clear niche. Do you see a better place for it or is it ideally—you comprise the base chunk of the budget, do you not?

Dr. Calio. My own personal view of that?

Mr. McCurdy. Yes, sir.

Dr. Calio. I'd like to see us stay right where we are. I have a good relationship with the Secretary. The Secretary has a good relationship with the President. I feel if we do our job and build our programs in the proper way we can sell them to the Department, who can sell them to the administration in an effective way. So, my personal view is, because I have that ability to communicate with the Department, I think it would be a disadvantage if we were an independent agency.

Mr. McCurdy. Even if the Department picks up a lot of the international aspects or more so? Is this more just an appeasement to some of us who say we need to compete with the Japanese and MITI or is it, in your opinion, a valid objective of commerce?

Dr. Calio. I'm not well versed enough or have the experience in that.

Mr. McCurdy. You sell yourself short, but I will let you escape on that response, but——

Dr. Calio. You're not going to get an argument from me.

Mr. McCurdy. Well, I understand the considerations you have in the future. I'm not trying to lay work for the other body.

Dr. Calio. I might add, along the lines of remaining in Commerce, we're very fortunate to have a Secretary of Commerce who has remained as Secretary of Commerce for 4 plus years. I think this Secretary has come to understand and know NOAA and its many successes and failures and problems and issues, so there's a great advantage in not having to create that new communication link, wherever we may end up, as an independent agency or within another department or staying—something else happening to us.

Mr. McCurdy. Well, I would agree that you do have a good relationship and that the Secretary has been very cooperative in some of my concerns and demands and has been very receptive and I appreciate the working relationship always. And also, but I'm afraid that sometimes they don't—4 years is a long term for any Secretary and for him to make it a full 8 may be very novel. I hope that they continue to support NOAA.

On contracting out, on A-76 and then since I sit on the Armed Services Committee we deal with this issue a great deal—in last year's budget, NOAA projected that contracting out certain functions to the private sector would save more than $6 million. This year it is projected to save more than $8 million. How much will NOAA actually save in 1985 as a result of the A-76 studies?

Dr. CALIO. In 1985?

Mr. MCCURDY. This is an evaluation of what you think has occurred or will occur?

Dr. CALIO. OK, I'm advised about $3.1 million.

Mr. MCCURDY. So, about half of what the projection was?

Dr. CALIO. Yes, sir.

Mr. MCCURDY. Do you have a reason for that? Justification?

Dr. CALIO. I think some of the delay in some of the events that had to take place in the whole A-76 process. I might add, on the other side, the way we come about these numbers is pretty much the application of a formula that is provided to us by the office of the Federal Procurement Policy, based on the number of studies we have in place, a few other ingredients into that formula, we essentially grind out a number and from the effort that we have in place the estimate then for fiscal year 1986 is about $8.1 million. About half of what the total effect would be if all of them were put on contract.

Mr. MCCURDY. But you're still online for the further contracting out in the future?

Dr. CALIO. Yes, sir. There were 30 in the fiscal year 1986 and I think 10 more are going to be picked up. The 30 were begun in 1984.

Mr. MCCURDY. Would you agree with the statement that NOAA has been probably the most aggressive agency in the Federal Government in implementing contracting out?

Dr. CALIO. The entire Federal Government?

Mr. MCCURDY. That you're aware of?

Dr. CALIO. I don't know about the entire Federal Government. We certainly have been the most aggressive in Commerce, that's for sure.

Mr. MCCURDY. It's our opinion it may be in the entire Federal Government. Why is that? Is that your emphasis or direction or what——

Dr. CALIO. Well, I support the whole A-76 process and I think it should be something that should be occurring all the time. The question of whether it should be in this magnitude in the agency at the present time I'm not sure that that's necessarily an appropriate thing to do.

Mr. MCCURDY. Has it affected your agency's morale or have you been able to evaluate that response?

Dr. CALIO. Oh, I think it goes without saying that whenever we look at the whole concept of A-76 where their jobs may be transferred to the private sector, I think it is going to have an impact on personnel morale.

Mr. MCCURDY. Mr. Chairman, I certainly appreciate the opportunity to have sat in for you and to ask these questions and again I appreciate Dr. Calio's forthright responses. I would agree with the statement that—or the question that Mr. Wirth asked about Dr. Keyworth. For some reason Dr. Keyworth and I keep butting heads in our Committees, either Science and Tech or Armed Services and I don't believe that NOAA's research is poor quality work or that it's a bunch of pork-barrel programs and I would take strong exception to that. I would—I can assure you—as a matter of fact he's in front of my other subcommittee on Research and Development right now—and I think I'm going to go over there and make those statements there, but I wanted to let you know that concern and my continued support for the programs. As long as you're willing to be as responsive and understanding as you've been in the past. Thank you.

Dr. Calio. Thank you, Mr. McCurdy.

Mr. McCurdy. Thank you, Mr. Chairman.

Mr. Scheuer. Thanks, Dave. Thanks for helping out.

Okay, Mr. Calio, you're proposing rescissions in fiscal 1985, about $105 million.

Dr. Calio. Yes, sir.

Mr. Scheuer. Including the absorbtion of funds from the Polar Satellite Program, Sea Grant, coastal zone management, and so forth. Now, with NOAA at 0.1 percent, 1-tenth of one percent of the total Federal budget, you've got them absorbing 8 percent of the rescissions. Now, we all understand around here that these are tough times and we all have to share the burden, but we've heard from our President and other leading members of this administration that the burden-sharing must be fair. Can you give us any rational explanation as to why NOAA is bearing 80 times its proportional share of this rescission package?

Dr. Calio. Mr. Chairman, rather than looking at percentages I think we have to look at the ingredients associated with those rescissions. There are three major elements, as you pointed out: Polar Orbiter, the Sea Grant Program and the Coastal Zone Management Grant Program. In the case of the latter two we feel that the Federal Government has done the job that it was supposed to do, in both of those areas, in the Coastal Zone Management Grant support and the Sea Grant activities. We've put $440 million into the Sea Grant Program. We have helped the coastal states in setting up coastal management programs, which was the original intent of the Coastal Zone Management Act and it was not the intent that the Federal Government would keep operating those state agencies, so it's important at this point in time for us to consider again, priorities and reducing the cost of the Federal Government and having the states bear the cost for those functions, especially at a time when the Federal Government is looking at $150 to $200 billion dollar deficits and State governments are experiencing surpluses.

Mr. Scheuer. Well, I can't really speak to that because it's not in my jurisdiction. That's in the jurisdiction of Merchant Marine and Fisheries. Let's excise from our consideration the Coastal Zone Management Program, which I don't know anything—I know very little about it—and it's not in the jurisdiction of this Committee. How about the rest of it?

Dr. CALIO. Well, the Sea Grant is another big part of it. It's $40 million and as I pointed out—or $39 million, as I pointed out we have put $440 million of taxpayers money into establishing those educations institutions, which was the purpose for establishing Sea Grant for studying the marine sciences and building the expertise in the country, that has been done. We have that capability across the board in the Nation and now it's time for the States and other elements to pick up the cost.

Mr. SCHEUER. Well, I'm back to the same song. Sea Grant is also not in the jurisdiction of this committee, so I can't contest with you on that.

Dr. CALIO. That's $70 of the $100 million, sir.

Mr. SCHEUER. The two of them together?

Dr. CALIO. Yes, sir.

Mr. SCHEUER. $70 of—so, instead of being 80 times——

Dr. CALIO. $80—excuse me, it's almost $80 million of that $100 million in rescissions.

Mr. SCHEUER. So, instead of, in other words, instead of being 80 times its proportional share it's maybe 15 or 16 times its proportional share.

Dr. CALIO. We didn't look at the percentages, sir. We were looking at those programs based on——

Mr. SCHEUER. Yes; but you can get some overall perception. Why are your cuts on the NOAA, which comes under the jurisdiction of this Committee, bearing let's say around 15 or 16 times their percentage, their pro rata percentage of the percentage that other Government agencies are taking? See, I cut the $100——

Dr. CALIO. I know you did, sir. I think the satellites are also in there. The second polar orbiter. Let me just check. Just accounted for it all. $38 million is the second polar orbiter.

Mr. SCHEUER. Well, I would say that—did you have the sense that you might be in trouble with Congress on that second polar orbiter, judging from what's happened here in prior years.

Dr. CALIO. Yes, sir.

Mr. SCHEUER. It would be unkind of me to talk about the Bourbon kings who learned nothing and forgot nothing, so I won't bring that up. You've been very candid.

Now, NSF, NASA and EPA all had significant increases in their R&D budget, yet this poor little baby that we're talking about, the NOAA R&D budget contains a decrease in R&D of over 35 percent. From $268 million to $169 million.

Dr. CALIO. A major fraction of that is Sea Grant again, sir; $40 million, $39 million and the rest of it are different elements of the program. We talked a little earlier about mesoscale convective complexes or mediumscale research. We are trying to put the priorities forward to build the instruments that will allow us to measure the atmospheric phenomena, like the NEXRAD, like the PROFILER, like the AWIPS.

Mr. SCHEUER. Well, what are you doing about NEXRAD? We get the impression that NEXRAD is about to get the axe. That you're just going to take something off the shelf?

Dr. CALIO. No; we're going to evaluate—we hope to evaluate, I'll put it that way, off the shelf capability with the NEXRAD development and take it through a validation test in fiscal year 1986 so we can make a decision on how—what to field and what procurements to make.

Mr. **Scheuer**. How long a delay is that going to cause?

Dr. **Calio**. About 6 months.

Mr. **Scheuer**. Have you developed a criteria by which you're going to judge NEXRAD with this system that you're going to take off the shelf.

Dr. **Calio**. I think the total test specifications have been developed. We're in the process of doing that right now. We will do that before we test any of the articles.

Mr. **Scheuer**. We have a hearing in a couple of weeks on NOAA. We'd like to have a look at your criteria by which you're going to compare NEXRAD with this inexpensive system you're going to take off the shelf.

Dr. **Calio**. May I just modify that a little bit. We'll give you what we have at the present time, sir. I don't think we have all the criteria complete, but I think we probably have a good feel for the rest of it.

Mr. **Scheuer**. How soon will you get the rest of it.

Dr. **Friday**. Sir, the test evaluation——

Mr. **Scheuer**. Would you like to come up to the table.

Dr. **Calio**. This is, excuse me, Dr. Friday, Deputy assistant administrator of the National Weather Service.

Dr. **Friday**. Sir, the test evaluation specifications for NEXRAD are in the final coordination processes now with all three agencies. That was a part of the validation phase. That's a part of the program that will be undertaken in the fiscal year 1986 timeframe to test the prototype systems developed by both of the contractors competing at the present time for the NEXRAD contract. Those same specifications will be used, those same procedures will be used to test any off-the-shelf equipment that we may be testing and evaluating.

Mr. **Scheuer**. If you go for this off-the-shelf system, isn't it likely that the Department of Defense will abandon the Tri-Agency Program, where there was some sharing involved in the expense of NEXRAD, and they'll just go their own way and buy their own system independently? Isn't it likely that that would be a result and if it is, would there be any saving from your having compromised the quality of your own system in taking something off the shelf?

Dr. **Calio**. Well, I'm not sure of the first premise. I would certainly—I'm sure that Dr. Friday will share this with me. We would probably work very closely with the Department of Defense to make sure that we keep the three agencies together.

Mr. **Scheuer**. Do you think the Department of Defense is likely to take something off the shelf, rather than a high-tech state-of-the-art system that was designed to suit their needs?

Dr. **Calio**. If they can satisfy their needs at a lower cost I would hope that the Department of Defense would do that.

Mr. **Scheuer**. Well, if it would satisfy their needs off the shelf we wouldn't need any high-tech, would we?

What communications have you had on this matter with DOD, up to now?

Dr. **Calio**. May I ask Dr. Friday to answer that?

Mr. SCHEUER. Sure.

Dr. FRIDAY. Sir, at this stage of the game there has been communications at the informal level within the NEXRAD joint systems program office, which is staffed with Department of Defense, Department of Transportation, and NOAA personnel.

Mr. SCHEUER. Now, they're aware of the fact over at DOD that you're thinking of scrapping NEXRAD and just contracting something——

Dr. FRIDAY. They're aware of the fact at DOD that we are developing plans to test commercially available, off the shelf Doppler radars, which might be able to satisfy our needs. They are aware of that. We are coordinating with them along——

Mr. SCHEUER. Are they participating with you in putting together these test criteria?

Dr. FRIDAY. The test criteria that are being put together now, yes, sir. That's a triagency effort in putting together that test.

Mr. SCHEUER. And who will do the test?

Dr. FRIDAY. At present time we are proposing that an independent test and evaluation agency do the testing, not only for the NEXRAD prototypes produced by the two contractors, but also for any of the off-the-shelf equipment that we might be testing. That is the Air Force Operational Test and Evaluation Command. It is the command that will be carrying out the required test for the NEXRAD prototypes. It is a logical choice then to carry out the test for any of the off-the-shelf equipment.

Mr. SCHEUER. Let's make a hypothetical case in which they felt that this off-the-shelf system was not sufficiently sophisticated for their needs. Would it not be inefficient and very, very much cost ineffective to have separate military and civilian weather radar systems up there, duplicating each other?

Dr. FRIDAY. That's exactly the premise that was used back in 1979, which as a major decision by OMB at the time all three agencies were directed to go together to produce a common radar satisfying all three agencies needs.

Mr. SCHEUER. And that's in the process taking place now?

Dr. FRIDAY. That is what NEXRAD is at the present time, is a common program.

Mr. SCHEUER. And, no; I mean the Department of Defense is involved as a full, equal partner in putting together the criteria for this testing process and also conducting the testing?

Dr. FRIDAY. Yes, sir.

Mr. SCHEUER. OK, well I think we'll be interested in seeing what those results are and I guess we shouldn't prejudge them, should we? The hour is getting late, we're expecting a roll call vote imminently, so I'm going to adjourn this hearing. I thank you very much, both of the witnesses, Mr. Calio.

Dr. CALIO. Thank you, Mr. Chairman.

Mr. SCHEUER. For your patience, your forbearance and I will ask you to get the information on this testing process, the criteria and the process of actually doing it, up to us as soon as possible and I think we'll like to have a look in it and think it through with you, OK?

Dr. CALIO. Yes, sir. We'll do that.

[The material referred to follows:]

## PROPOSED TEST PROGRAM FOR "OFF-THE-SHELF" DOPPLER WEATHER RADAR SYSTEMS

### Test and Evaluation Outline

The purpose of this outline is to provide major test objectives for comparing the compliance of doppler radar system(s) with NEXRAD requirements. It describes the efforts necessary to meet effectiveness and suitability criteria.

### Organization Assumptions

This test approach is based on the assumption that an independent test agency (AFOTEC) will conduct tests of off-the-shelf radars, and will report the results to high level tri-agency (DOC, DOD, DOT) managers. We will also provide test results to NOAA, DOC, OMB, and the other participating agencies.

### Scope

This test effort will consist of two major levels:

- System level technical performance assessment testing (including software performance testing)
- Operational testing at selected site

### Test Objectives

Test objectives are designed to provide information necessary to evaluate system performance relative to the joint agency performance and operational requirements. Test objectives address the following critical issues.

- Performance - provide accurate and timely warnings of both hazardous and routine weather events
- Availability - provide a reliable, maintainable and logistically supportable system to meet operational requirements
- Responsiveness - effectively react to multiple users' needs
- Growth Capability - Capability to accommodate system expansion and update in the future
- Interoperability - operate with existing weather systems

The minimal set of tests required to demonstrate system effectiveness include evaluation of:

- Accuracy of velocity, spectrum width and reflectivity radar data
- Accuracy of products
- Compliance with electromagnetic radiation requirements
- Compliance with full load requirements
- Compliance with response time requirements
- Compliance with throughput requirements
- Compliance with environmental requirements
- Compliance with ground clutter suppression requirements
- Compliance with minimum detection capability and dynamic range requirements
- Compliance with monitoring and error detection requirements
- Compliance with radar signal processing requirements
- Accuracy of warnings
- Timeliness of warnings
- Adequacy of automated alerts
- Usefulness/adequacy of products, including method of presentation of data
- Multiple user support/responsiveness, including remote distribution of data
- Operator-machine interface
- Operator workload
- Usability by specific skill levels
- The effective range capability for detection of tornadoes, mesocyclones, severe weather and quantitative precipitation
- The accuracy of rain-rate and wind velocity estimates

The minimal set of tests required to demonstrate system suitability include evaluation or assessment of:

- The capability to comply with the required radar spectrum engineering criteria of the Manual of Regulations and Procedures for Federal Radio Frequency Management
- System update/growth capability
- Technical documentation adequacy
- Part count/replaceable unit suitability
- Suitability of the volumetric coverage provided
- Software supportability/maintainability
- System reliability
- System maintainability
- System availability
- Compliance with unattended radar transmitter site operation requirement
- Maturity/stability of software
- Safety aspects of operations and maintenance

## Methodology

Tests will compare off-the-shelf capabilities with all joint agency technical requirements.

Tests will compare off-the-shelf capabilities with all joint agency operational requirements in a realistic operational environment.

Mr. **Scheuer**. OK. Thank you very, very much for your testimony.

Dr. **Calio**. Thank you.

Mr. **Scheuer**. This hearing is adjourned.

[Whereupon, at 4 p.m., the subcommittee recessed, to reconvene at the call of the Chair.]

# FISCAL YEAR 1986 NOAA AUTHORIZATION

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THURSDAY, MARCH 21, 1985

House of Representatives, Committee on Science and Technology, Subcommittee on Natural Resources, Agriculture Research, and Environment,
*Washington, DC.*

The subcommittee met, pursuant to notice, at 1:40 p.m., in room 2318, Rayburn House Office Building, Hon. James H. Scheuer (chairman of the subcommittee) presiding.

Present: Representatives Scheuer, McCurdy, Valentine, Schneider, Smith, and Henry.

Staff present: Dr. Robert E. Palmer, science consultant; Daniel Steinway, counsel to minority; and George S. Kopp, staff director/counsel.

Mr. Scheuer. The Subcommittee on Natural Resources, Agriculture Research, and Environment will come to order.

Today, the subcommittee will consider the 1986 budget request for NOAA, the National Oceanic and Atmospheric Administration. This is the second in a series of hearings that we'll be holding on their budget request. We'll be focusing specifically on the request for the National Weather Service. It's a matter that we've been deeply concerned with. We've had nine hearings in the last year or two on the National Weather Service. This will be the tenth devoted to examining the present and future needs of the National Weather Service and how this Congress can do the job that the American people want us to do.

We know very well from our past hearings that the National Weather Service is stretched to the breaking point. The funding for the Weather Service has not kept up with inflation; personnel have actually declined, something on the order of 14 or 15 percent in the last 8 years; and, these reductions are particularly painful when one realizes that the satellite technology, the radar capability, and the computing power that are now available give us a potential for revolutionizing weather forecasting in this country in the very near future. We have it within our grasp if we will but reach for it.

The fiscal 1986 budget proposal for the National Weather Service does contain some encouraging technological initiatives—programs which, in the long run, will enable the Weather Service to operate in a more automated and a more efficient fashion.

However, we must keep in mind that in the long run we'll all be dead. The question is, how do we survive until the long run? This budget does promote a number of policies that we think will hurt the Weather Service and cripple it and which we have consistently resisted in the past. Closing of local weather stations and elimination of many traditional services such as agricultural weather service, on which our farm industry relies so heavily; steady, consistent, and systematic reductions in personnel levels well in advance of the time when automation might make such reductions prudent and bearable; reductions in long-term research and development necessary for upgrading both meteorological technology and basic understanding.

Today we'll hear testimony from both public and private witnesses on the merits and demerits of these various proposals. We'll be examining in some detail the administration's proposal with respect to procurement of the next generation of radar systems, what we call in governmentalese, NEXRAD—the next generation of radar, which has been very strongly supported by this committee and by this Congress since the program's inception in 1979.

The signals we seem to be getting from 1600 Pennsylvania Avenue—from the administration—seem to be that in this budget, that NEXRAD is out; that it can be dispensed with; that it can be disposed of; that the NEXRAD planning and development efforts that have taken place over 5 long years that were expensive and time consuming and involved the brain power and the effort and commitment of thousands of people were all unnecessary. Also, that a first-rate radar capability has been available all the time—just sitting up there on the shelf—and all we had to do was pluck these various elements of a system off the shelf and we could fulfill our needs for the next generation radar system for this country.

Now the administration may very well be right. But, given that NEXRAD will be the Weather Service's storm detection system at least for the next quarter of a century, I for one do not want to compromise the safety of the American public until all the evidence is in. This proposal will receive intensive scrutiny from the subcommittee.

Before we turn to our first distinguished witness, I would like to turn to our very thoughtful and contributing ranking minority member, Congresswoman Claudine Schneider of Rhode Island.

Ms. SCHNEIDER. Thank you, Mr. Chairman, and I commend you for calling this hearing today so that we could review with this very distinguished group of witnesses, some of the specific comments on where the Federal Government should go or continue to go insofar as the future for the Nation's Weather Service Programs.

I support a modern up-to-date technologically sound National Weather Service Program, but the real question is, How do we proceed from here given our budgetary constraints? Certainly, NEXRAD, as the chairman referred to, has the unique ability to provide for the accurate and early storm-warning systems, but there's also some question as to perhaps whether we should be relying more, or continue to rely, on some of the off-the-shelf radar for inclusion in the weather system network.

There's very little question that it's our responsibility to try to enhance our Nation's safety and to protect the people and the resources from the threats posed by severe weather and dangerous storms. Representing a State where the fishing industry is completely reliant on the reports from the Weather Service and the detailed maps of NOAA, it's very important that we have the opportunity to provide this information to the public. We are seeing decreasing personnel levels, consolidation of some of the existing weather stations; we're all seeing much discussion about the role of the private weather services in meeting some of the private sector specific data needs. I think these are the kinds of questions that I'm anxious to have answered by the witnesses today.

As I said before, we are faced with considerable spending constraints and what this committee will be doing is to attempt a cost-benefit analysis of the various technological options. So, I'm hopeful that this illustrious crew of witnesses we have here today will give us the appropriate insight. Thank you, Mr. Chairman.

Mr. **Scheuer**. Thank you, madam ranking minority member. Congressman Bob Smith.

Mr. **Smith**. No comments, Mr. Chairman.

Mr. **Scheuer**. Congressman Paul Henry.

Mr. **Henry**. No comments, Mr. Chairman.

Mr. **Scheuer**. We'll start out with our first witness, Mr. Bob Ryan, of WRC–TV, here in Washington.

Mr. Ryan, you're getting to be an old perennial at these hearings. It's nice getting you on the first full day of spring. We had sort of a half a day yesterday; maybe you can give us a long-term weather prognosis and tell us what spring is going to be like.

I have to say that whenever we get into the business of looking at our National Weather Service and looking ahead and wanting to find a very thoughtful, incisive, creative, professional view on what the problem is and where we ought to be going, we seem to always get back to Bob Ryan of channel 4 in this town. It's a pleasure to have you again with us, Bob. I would say, chat with us and take such time as you may need and I'm sure we'll all have some questions for you.

## STATEMENT OF ROBERT T. RYAN, NBC METEOROLOGIST, WRC-TV, WASHINGTON, DC

Mr. **Ryan**. Thank you very much, Mr. Chairman. I hope you have those remarks on tape. It's always a pleasure to take part in the democratic process and let me just preface my remarks by the statement that these are entirely my own personal views and not meant to reflect the views of WRC–TV or NBC.

This is indeed an exciting time for meteorologists. Whether we are meteorologists involved in broadcasting or for the National Weather Service or for private companies, as you so rightly pointed up. The evidence for that is that in 10 days, we'll be celebrating the 25th anniversary of the launch of the first weather satellite. Our first pictures from space were rather crude, blurred images showing cloud masses. Now, through the advances in satellite meteorology and technology, we are able to watch thunderstorms that may produce tornadoes, hurricanes, as evidenced by this dramatic picture of Hurricane Diana, almost minute by minute. This is an example of the dramatic strides that we've made in the field of meteorology in a rather short time.

In the years ahead, we can foresee the improvement in short-range and small-scale forecasting, the national network of Doppler radars, greater use of remote sentencing; and, to continuously monitor the atmosphere, the use of more sophisticated and faster computers and computer models to make forecasts even more reliable and extend our forecasting skill many days beyond what is now possible.

I'd like to draw your attention to the statement that I included with my statement of the American Meteorological Society, which was a group of us that got together in the summer of 1983 to draft this statement. It's the atmosphere and environment: An agenda for action. It captures some of the excitement and the potential in the field of the atmospheric sciences.

When we think about it, very few sciences impact almost every American, each and every day and impact our economy by billions of dollars each year. Very few sciences are dealing with something which directly or indirectly claims hundreds of lives each year, and yet, for which we spend on a national effort, only about $2 per capita each and every year to observe, research, and forecast. I must say, in the years that I've been broadcasting and dealing with the public, I have never had anybody come up to me and say,

> You know that four cents a week it's costing me to know whether it will rain or snow tomorrow, and to protect my sister from tornadoes in Oklahoma, and to let us know about the potential of flash floods and to watch the skies continuously from space for hurricanes, that four cents per week is too much money. We are really wasting our taxpayer's dollar for all we're getting from meteorologists and meteorology.

I think for what we're spending and for the effort, it's a real bargain for the taxpayer. I've never had anybody complain to me about what we're spending.

Some of the excitement of meteorology today is reflected in some of the programs you mentioned; NEXRAD, GOES NEXT, PROFILER, PROFS, all these acronyms that really reflect the state-of-the-art and the research that's now underway. These are programs that require years to develop and maintain before dramatic results are seen. We are right now on the threshold of some of those dramatic results and the payoffs in the near future. I'm afraid some of the proposed budget cuts will only increase costs in the long run and delay the benefits for everyone.

What are we really saving by reducing the NEXRAD Program by $7 million when a result may be a delay of 1 or 2 years before NEXRAD reaches the field and maybe just one killer tornado is missed because of that delay. The cooperative effort involving several Government groups, it seems to me, is a unique undertaking and really an efficient use of the taxpayer's dollar. If there's a better system or an equivalent system that's commercially available, I'm sure everybody who is working in the field trying to forecast tornadoes and dangerous wind shears would welcome that right now. Why not continue the NEXRAD funding, keep the program on track so as not to delay limited production of NEXRAD, and, at the same time, request a study from the National Academy of Science to determine the relative merits of NEXRAD at any existing commercial Doppler system?

It seems to me that when we consider weather services, rather than saying here's something that affects everyone; impacts the country by billions of dollars each and every year, how much should we spend to do the best job we possibly can? All too often when we're considering the budget of the weather services of this country, we say what's the minimum we can do? If we agree that the principle function of a Government is the protection of life and property of the citizens, it just seems that the National Weather Service and all our weather services are doing that each and every day. Shouldn't we really be considering what's the best job we can do rather than what's the minimum.

Yes, we can get by with one polar orbiter satellite as proposed for fiscal year 1986 budget. Now we know what it's like when we have one geostationary satellite. Every time we have an orbital maneuver, when we change the position of that geostationary satellite from the winter to the summer season, the meteorological community holds its breath. Polar orbiter and GOES are not esoteric scientific satellites which are conducting some fascinating research which we may see the payoff for in some years down the road. These are critical operational elements of our ability to observe and forecast the weather for the country. One polar orbiter will limit our ability to observe the weather and leave us with no backup. Are we not being penny wise and pound foolish trying to do the minimum?

Let me talk about the public and the private mix. We've had this discussion before. Let me just say, it's been my observation that the public and the private mix in the meteorological communities really have an excellent working relation where we're using the skills and the needs of each sector complementing each other. I think that's really as it should be. As an example, the broadcast meteorologists have improved the technical tools that we have for use in broadcasting, and have also upgraded all of the meteorological tools that we need. A significant number of broadcasters have full meteorological offices now; some round-the-clock operations; radars; local observer networks; satellite ground stations; even a few with Doppler radars. However, all meteorologists, whether we are broadcasters or in the private sector, are dependent on the National Weather Service for the basic meteorological products and data. The use of sophisticated equipment in displays by broadcast meteorologists only complements and expands the basic service to the public of our colleagues in the National Weather Service.

In carrying out its mandate, the Government does provide essentially free data and products to broadcast meteorologists and private meteorologists, as the Government also does to a number of foreign governments that access the data, but when the broadcast meteorologist has more information to better inform and serve the public and when the forecast from a private company results in improved profits for a number of companies, therefore improving the tax return to the Government, doesn't really the taxpayer get his money back that way too? And, he's better served by what we're doing.

I'm not so sure that everybody benefits if we would begin to replace National Weather Service personnel and observers with private contractors. It seems to me that for the entire weather system to function most efficiently, it is important to have an integrated unit of observations and communications. It's my understanding that the contract personnel have to report back through regional, rather than through the local forecast office. I know in my own experience if I want to get a bit more information or have a question about an observation here at National Airport, that's a contract observer at National Airport. I cannot talk to him directly. I may not be able to get additional information because it's not in the contract. I don't know that that is the way that we want the weather services and our observations we rely on all so much to really function in the most effective way.

In conclusion, I hope we keep in mind that the budget decisions being made are about a science which daily touches everyone's life; a science which is rapidly advancing and using all areas of American technology to benefit all the citizens at a price that is still a bargain for the country. I would hope that this country's dedicated public and private scientists, working in the atmospheric environment, will continue to get the support they need to maintain and expand our understanding of and ability to forecast our Nation's weather. Thank you, very much.

[The prepared statement of Mr. Ryan follows:]

Before the

SUBCOMMITTEE ON NATURAL RESOURCES,
AGRICULTURAL RESEARCH AND ENVIRONMENT

of the

COMMITTEE ON SCIENCE AND TECHNOLOGY

of the

U.S. HOUSE OF REPRESENTATIVES

# STATEMENT

OF

ROBERT T. RYAN

NBC METEOROLOGIST

WRC-TV, WASHINGTON, D.C.

MARCH 21, 1985

## STATEMENT OF ROBERT T. RYAN

This statement is my own personal view and in no way is meant to reflect the views of WRC-TV or NBC, Inc.

### INTRODUCTION - An Exciting Time

This is an exciting time for meteorologists. Whether we are involved in atmospheric and hydrological research, observing our ocean of air, forecasting and or disseminating information and forecasts to the public or to private clients. Whether we work for the National Weather Service, private companies or even appear on television, it is an interesting and exciting time to be a meteorologist.

In a few days we will celebrate the 25th anniversary of the first weather satellite. Only a short time ago we could see only general blurred cloud masses, now we can watch tornado producing thunderstorms, hurricanes, crippling snow storms almost minute by minute. Few areas of science face the complexities and challenges of meteorology and are able to make use of so many of the recent technological advances in space, computer science and communications. In the years ahead, building on the advances we have made, we foresee dramatic improvement in short range and small scale forecasting, a national network of doppler radars, greater use of remote sensing to continuously monitor the atmosphere, the use of more sophisticated and faster computers and computer models to make forecasts even more reliable and extend forecasting skill many days beyond what is now possible. I draw your attention to a statement of the American Meteorological Society of September 1983, The Atmospheric Environment: An Agenda for Action. These are indeed exciting times for meteorologists and everyone working to better understand and forecast our ever changing ocean of air. However, I can think of no science which impacts almost every American every day, as the weather does, no science which impacts our economy by perhaps billions of dollars each year, as the weather does, no event which annually claims, directly or indirectly, as the weather does, hundreds of lives and yet which costs the country only about $2 per capita per year to observe, research, and forecast. I have yet to hear anyone say to me, "you know that 4¢ per week it's costing ~~me~~ to know if it will rain or snow tommorrow; that 4¢ per week that will warn my sister in Texas if a tornado is approaching; that 4¢ per week that allows you meteorologists to watch for hurricanes, thunderstorms, high winds, floods; that 4¢ per week that helps me plan my weekend and how I should dress my children in the morning... you know that 4¢ per week all that's costing me... that's too much money... that's a waste of the taxpayers money." No one has ever said that to me because for what this country gets for its expenditure for weather services and weather data, it's getting a real bargain.

## PROGRAMS AND FUNDING

Some of the excitment of meteorology today is reflected in such programs as NEXRAD, GOES NEXT, PROFILER, PROFS, AWIPS, VAS, TOGA. Programs and research which require years to develop and maintain before dramatic results are seen. Yes we will see important payoffs in the near future; however, some proposed budget cuts will only increase costs in the long run and delay the benefits for everyone.

What are we saving by reducing the NEXRAD program by 7 million dollars when the result may be a delay of one or two years before NEXRAD reaches the field and maybe just one killer tornado is missed because of that delay. This cooperative effort involving several governmental groups is a unique undertaking and is a very efficient use of the taxpayers dollar. If there is an equivalent, better, or less expensive system now commerically available, I am sure the scientists in the NEXRAD program and those meteorologists trying to forecast killer tornados and dangerous airport wind shear would welcome it. Why not continue NEXRAD funding, keep the program on track so as not to delay limited production of NEXRAD and at the same time request a National Academy of Science study to examine the relative merits of NEXRAD and any existing commercial doppler system.

Why is it that when we consider our weather services, rather than saying, "Here is something that effects everyone and impacts the economy by billions each year, now how much should we spend to do the best job we can;" all to often we say "what's the minimum we need to do the job." If we agree that the principal function of government is the protection of the lives and property of its citizens then is it not our National Weather Service that does this day in, day out. Shouldn't we be doing the best job rather than looking for the minimum? Yes we are all aware of the deficit and the need to cut back unneeded government spending. But are we best serving the American people by seeking the minimum to protect their lives and property.

Yes we could get by with one polar orbiter satellite as proposed for FY 1986. But we see now what it's like with one geostationary satellite when every time an orbital manuver is made, the meteorological community holds its breath. Polar orbiter and GOES are not some esoteric scientific satellite conducting some fascinating experiment which may have practical importance years from now. These are critical operational elements of our ability to observe and forecast the weather for the country. One polar orbiter will limit our ability to observe the weather and leave us no backup. Are we not being penny wise and pound foolish trying to get by with the minimum?

## THE PUBLIC - PRIVATE MIX

For years the public and private meteorological communities have had an excellent working relation and the skills and needs of each sector have complimented the other as it should be. Over the years broadcast meteorologists have improved both technical tools for weathercasts and for needed meteorological support. A significant number of broadcasters have full meteorological offices, some round the clock operations, radars, local observer networks, satellite ground stations, even doppler radar. However, all meteorologists regardless of the sophistication of their local operation, require the input of and are dependent on the National Weather Service for the basic meteorological products and data. The use of sophisticated equipment and displays by broadcast meteorologists only compliments and expands the basic service to the public of our colleagues at the National Weather Service. At a recent AMS Conference on Broadcast Meteorology almost 80% of broadcast meteorologists rated their working relation with the local NWS office as excellent or good, 20% said fair and only one respondent out of more than 100 said poor.

Yes, in carrying out its mandate, the government weather services do provide essentially free data and products to private and broadcast meteorologists; as the government also does to foreign governments. But when the broadcast meteorologists has more information to better inform and serve the public and when the private meteorologist can serve a client with a specialized forecast (as the private rather than the public sector should do) doesn't everyone really benefit and the taxpayer still get a return on his investment in our "free" weather data. For example, if a major trucking company gets a private weather forecast which allows the company to schedule its fleet to avoid strong head winds, it may save the company hundreds of gallons of fuel. The meteorological company makes a profit on its forecast, the trucking company is more profitable, more taxes are collected from more profitable companies and we've conserved energy to boot. Everyone benefits.

I am not so sure everyone benefits when we begin to replace NWS observers and personnel with private contractors. For the entire weather system to function most efficiently, it is important to have an integrated unit of observations, and communications. It is my understanding that contract observers report to the regional office rather then the local forecast office and I know it is not possible for me to talk to the observer at National Airport or obtain any data or information since its "not in the contract." This new system raises the spectre of complicating and making more costly a rather efficient and interwoven system of observers which has served us well for years. Additionally, such changes have a demoralizing effect on some NWS personnel.

## CONCLUSION

In conclusion I hope we keep in mind that budget decisions are being made about a science which daily touches everyone's life. A science which is rapidly advancing, using all areas of American technology to help benefit all the citizens at a price that is still a real bargain for the country.

I would hope that this country's dedicated public and private scientists working in the atmospheric environment will continue to get the support they need to maintain and expand our understanding and ability to forecast our nation's weather.

Thank you.

Mr. SCHEUER. Thank you very much, Bob. We're going to be on the 5-minute rule so that we have a chance to get everything in.

Can I ask you, how much community education work do you do and is community education work important? I say that because we have a pretty clear feeling here that the cuts in the community education program of the National Weather Service exacerbated the impact of the killer Carolina tornadoes of March of last year. We're concerned that these cuts, if they continue, will really take a toll in human lives and vast amounts of dollars, astronomically out of proportion to the amount of dollars we've saved through the cuts. If this is just hysteria, I want you to tell me. What do you do in the way of community education, how important is it, and do you have any knowledge or belief that the cuts in community education program may have worsened the situation in last year's Carolina tornadoes?

Mr. RYAN. I have no direct knowledge, but I had heard that also, that there was concern that the public and the people living in that area had not been as well informed as to what action they might take when they heard these things.

Part of the weather is that it touches the people personally. Anything that I can do or that the Weather Service can do to get people into the field, to let the general public know that there is a meteorologist there, know what the person is that they are dealing with, I think is important. I think it is important insofar as when the need arises, to take some action so that they have an understanding of what the possibilities are; what is the state of the science; should I believe that warning that comes out; what do I do when there's a watch issued; what action should I take: That's the way when lives are at stake, when action is taken, people believe that the person issuing that warning knows what he's doing and they are informed and have been educated a bit as to what they should do. That's when it's important. For years we have had a large and very good public education side to the Weather Service function. I do it on my own visiting schools, one to two schools per week; talking with children; talking to community groups. It's an important function of what any meteorologist does whether he's in broadcasting or in the public service.

Mr. SCHEUER. How much does WRC-TV pay for the Weather Service for their weather data? Do you think the fees should be increased considering the fact that these TV networks and your station are for-profit institutions. If part of what they sell customers is up to the minute data on the weather they can expect, why shouldn't they pay the Government a larger percentage of the cost of the service?

Mr. RYAN. Some of the data that we do get, we do pay for, we operate through a company which you will hear from later, WSI in Boston, to receive much of the raw hourly data in such a way that it's an easy format for us. We also receive essentially free data through the facsimile circuit, all of which we use in preparing the forecast. Also, all of the satellite data essentially is free although we have an annual renewal fee which helps the administration of that. I think the main point is not the cost, whether there is a cost or not, but who is the ultimate beneficiary of the information. We are not selling the forecast to the general public; rather we are really complementing and working closely with what the prime function of the Weather Service is. If I can better inform the public and the person sitting at home by using additional data and additional information from radar displays, I think that's the prime thing that we're trying to do. Is the person sitting at home better informed and is he getting the information?

Mr. SCHEUER. So in that sense, you consider yourself an extension of the National Weather Service?

Mr. RYAN. Insofar as that we're informing the public.

Mr. SCHEUER. Their information and education branch.

Congresswoman Claudine Schneider.

Ms. SCHNEIDER. I'd like to followup on that line of questioning because it seems to me that as the recipient of a government subsidy which essentially the TV stations are, you're acting as a conduit to the public but yet you are still utilizing services that the taxpayer is paying for, and granted we taxpayers are delighted to be paying for that. As you said, 4 cents a week is no big deal. It seems to me that as we are reviewing subsidies throughout the government system, whether it be farm subsidies or subsidies to Amtrak or to airlines or whatever it might be, it's also our responsibility to review subsidies to the networks. I know that you are not here officially in the capacity of responding to WRC or your major network's responses, but don't you think that it seems fair that there be some kind of user fee that stations such as your own pay? After all, you are a for-profit business.

Mr. RYAN. Well I think your use of the term subsidies to describe the data that we use in providing information to the general public is perhaps taking the subsidies—NBC or any broadcasting company does not file any form to get a return of some information or a return of some investment which they have made. Rather, we are accessing and utilizing the data which is provided as a necessary part of getting the weather information and the forecast to the general public.

As an example, I would say the advances, realizing you're from Rhode Island and I was in New England myself, the 1938 hurricane which was devastating to Long Island and Rhode Island, what would have been the case in that if a small station in Rhode Island, able to access satellite information for either a nominal fee or for free, but then had to make a budgetary decision because there would be fees attached to accessing the data. I don't think the person living in Rhode Island could have been well informed and better informed and would opt for having their station have to pay some fees vs. getting a lot better information and being able to know exactly what was going on in a critical situation like that.

Ms. SCHNEIDER. If you are the recipient of this information, do you not think that it is appropriate that credit be given to NOAA as being the source of this information? I think it's always interesting to watch the weather reports but very rarely do any of the forecasters say that this information is the benefit of the National Oceanic and Atmospheric Administration. (See CRS study in appendix.)

Mr. RYAN. I can't say I do it each and every day, but I do it frequently and I think that—as a matter of fact, when we had a discussion a couple of years ago about perhaps selling the GOES satellites, I made the point that it was indeed NOAA's and the taxpayer's satellites that were being proposed for sale. I hope I do a good job of keeping everybody informed about the fine work of NOAA.

Ms. **Schneider**. I certainly was not picking on you specifically but it seems to me that perhaps somewhere during the weather forecast, there ought to be a symbol—NOAA's symbol or some indication—on all the different networks saying that this information is provided by NOAA.

I have another quick question. After an investigation into the Carolina hurricane, the damages that occurred there, there was a report filed and in that report there were indications that some of the damage could have been minimized had the networks not only had the spoken word go on the television programs that there was a hurricane and there was a warning, but rather the written word should have also been there. Investigators found that there were some people who were handicapped and had the televisions on—some deaf people who were watching Dallas—at the time they interrupted the program but didn't know why. No word came across on this. It seems to me that both the visual and the auditory message needs to be conveyed.

Mr. **Ryan**. I think part of this is that not every community has professional meteorologists who present the weather nor do they have fully staffed weather offices and this is another example where with support having a large weather office, indeed with a meteorologist there, I'm sure that they would interrupt. There are a number of interruptions of programming out through parts of the Midwest that are sensitive to tornadoes. I would fully support having meteorologists as weathercasters, too throughout the country. Unfortunately, while we're making a lot of progress and more and more are professional meteorologists, not all weathercasters still are meteorologists nor do they have the full staff and fully supported weather offices.

Ms. **Schneider**. Perhaps you can carry back to your network the recommendation that you have that followed and have the visual and the auditory message conveyed. Thank you, Mr. Chairman. (See CRS study in appendix.)

Mr. **Scheuer**. Now the distinguished and ever alert representative of Tornado Alley, the Honorable Dave McCurdy of Oklahoma.

Mr. **McCurdy**. Thank you, Mr. Chairman. Thank you, Mr. Ryan, for appearing today. I appreciate your testimony and I think you convey a lot of credibility. I know in the Washington area you have a high visibility and with that, I think you maintain the comparable credibility.

My question is, and I must say at the outset that I'm a strong supporter for the NEXRAD system and I think the administration and OMB are making a terrible mistake in trying to slow down the procurement in the deployment of the NEXRAD system, and I would appreciate it if you from the private sector side could enlighten us as to how you view NEXRAD. Specifically, to address some of those people that appear to be in the administration who would lean back and say wait a minute, we've taken meteorology and weather forecasting to such a high degree and high state of technology today, and it's such an art now that, why go further. Why go the next step? You've got the satellites and you see on the screen these "gee whiz" photos. Isn't that enough? How far can you really take this? Haven't we gone about as far as we need to go in weather forecasting?

Mr. **Ryan**. I think anybody that would look at some of the recent research having to do with Doppler radar, sees the great strength of that and what a powerful tool it will be when it is operational and a network of Doppler radars are across the country. I think also just looking at our existing network of radars, how long they have been in service, the type of radars that they are, they're doing their function and they're performing well. With some of the funding necessities, and taking a little bit from existing networks to try and keep ongoing research moving forward, I think the existing network is really being held together a bit with band-aids and paperclips.

Often the radar we tap into is frequently down. You look at the national radar summaries, and oftentimes there is an OM on the map—out for maintenance. We really need the next generation of radar to be in place and to be operational as soon as possible. It's an entirely new step. It's perhaps analogous to having the first tantalizing look at TIROS of the first cloud clusters against having detailed and very fine pictures from polar orbiter. I think we'll see that in Doppler radar.

Mr. **McCurdy**. Some of the critics within the administration, specifically OMB, would say that since there is a commercial application in Doppler radar, it's not that unique. Since weather stations in a number of large cities have Doppler radars now, why not just rely on a network of all these cities out there who have this radar. Why do you need a 200-system network throughout the continental United States? How would you respond to those critics?

Mr. **Ryan**. If you would rely on a private company to put in Doppler radar, they're not going to do it out of the goodness of their heart and they would expect a return on that. I don't think we ever want to get into the situation where we're charging or putting any sort of fee structure on something like tornadoes. I don't think we would ever want to get to the point where we say that we've got our Doppler radar on and we see that tornado coming and before we're going to tell you exactly when it's going to hit, you have to pay your $100 as a city or $5—the principal role of the government is protection of life and property and we'd better do the best job we can doing that.

Mr. **McCurdy**. Is it not true that many stations cannot afford these radars and there's not the total coverage that would be essential with a government——

Mr. **Ryan**. The stations that have it now—I know of two or three stations that have Doppler—in one case that I know of from talking to the meteorologist there, they have a very good and close working relation with the Weather Service. It benefits everybody. But, no, they do not have a wide network of stations that are going to invest a quarter of a million dollars or more as it is now in a Doppler system. Those stations are few and far between.

Mr. **McCurdy**. Very good. Thank you for your testimony.

Mr. **Smith**. One criticism that I think you've probably heard within your own field, and I know Willard Scott has addressed it a number of times, has been that broadcasting the weather tends to be the thing between the sports and the news. There's not much substance, but a lot of entertainment. Scott himself maintains that he's more of an entertainer than knowledgeable in the field. How do you answer that criticism in regard to the fact that essentially there are not user fees so you do essentially get free data and you use that data to some extent through the entertainment medium get that information out but not in a lot of depth in a 2 or 3-minute broadcast.

Mr. RYAN. Congressman, there are also committee hearings held every day all over the country, some in local grange halls and some on Capitol Hill, and there's a difference of importance of the range of hearings that are held. I hope that as we advance as a science and as broadcasters have more and more of the tools and some of the things that are coming out of research, my sense is that there is a greater credibility and I've seen this in the years that I've been in broadcasting—about 12 years now—and that it is an interesting observation that the news departments are one of the things that they really want to maintain credibility along the lines of when you need something, we're going to be there with the information.

Now that we are able to show these satellite pictures on a real time basis and things like Doppler radar and radar, people really take the forecast that is given each night more and more seriously and base their decisions on that and will act on that. It has become a very important part of the news across the country. More and more professional meteorologists are now presenting the weather and using more and more of the tools that we now have.

Mr. SMITH. Is there a large amount of communication between the networks in terms of your broadcasts or is simply going to the Weather Service, getting the information, and making up your own broadcast?

Mr. RYAN. There's not any sort of coordination between stations either locally or nationally. We do here a feed out of a national satellite sequence that stations across the country will use and the other networks do that also. Maybe there are some common products or some common graphics but as far as the actual forecast information, there is no—we don't have a committee decision on what the forecast will be for Washington. We do work very closely with the Weather Service. Here in our own situation we have a network of observers that we rely on so that I can report what the weather is out in Front Royal or south to Richmond. If one of our observers sees some severe weather and calls it in to us, I will pass that observation on to the Weather Service. I think that is in the best spirit of cooperation and complementing each other so we serve the public as best we can.

Mr. SMITH. Thank you.

Mr. HENRY. Maybe Mr. Ryan isn't the one to clarify this, but I certainly would like to learn from some of the other witnesses. I'm going through the testimony and listening to the questioning, I live right off Lake Michigan where our State motto is, "If you don't like the weather, wait 5 minutes." All our stations have had Doppler for years because of the tremendous changes when the winds come off the lake. The issue is getting this advanced Doppler technology across the board and into the National Weather Service. I think everyone seems to agree on that. Isn't the other issue between the administration and what we're hearing whether we should go to off-the-shelf technology as opposed to a second generation Doppler. Is that really what we're talking about? Is the issue between existing Doppler technology that your station buys off the shelf or is it the question of trying to pursue the additional investment for second generation Doppler? Is that really what we mean?

Mr. **Ryan**. I think it will come down to a technical question. There are a number of existing Doppler systems, two that come to mind. Whether we can make a judgment on the technical capabilities of one system over another in the NEXRAD program, I certainly can't address that issue.

I would say that this is a program that has been ongoing for a number of years and has been in the research and development stage for a number of years, As I mentioned in my testimony, I think until we have that answer, it does not seem to make practical sense to cut the program by $7 million right now just when it's getting ready to go in the field.

Mr. **Henry**. I guess the question there is in part whether you put the additional research money in, if, in fact, you have reason to believe the existing off-the-shelf technology is adequate. The issue isn't whether we're going to Dopplerize the service, the issue is really whether we're going to buy off the shelf or develop the new R&D second generation Doppler. Do I have that correct?

Mr. **Scheuer**. We're going to consider this in great detail in the next panel. We'll get into real depth then.

Mr. **McCurdy**. If Mr. Henry's not going to ask further questions, I just wanted to say something to Mr. Ryan. Just from my experience and being one who's watched weather for a long time and growing up in Oklahoma where we do have the severe weather, I think one of the best arguments that you have, and I hope you convey that to your public on a regular basis, is that because of the improvements in the technology there is more specificity in the type of warnings that you give. I can recall when I was very young that we had the sirens go off from the schools any time there was a dark cloud around or there was a sighting in the remote areas. After a while, people just ignored them. They just go to the point they were almost immune to the warnings. Today, when you're able to pinpoint and show on the screen where that cloud is and the impact that it can have and the direction that it is going, I think people are far more aware of the danger involved. I think the number of lives saved is certainly enhanced. I think that's one of the key jobs that you as meteorologists perform. I just wanted to—I hope that's a message that is constantly played out there—because I'm not sure that the people out there today in the administration and OMB are as thinking in that direction.

Mr. **Ryan**. I agree with you. It's a slow process and the progress we make is slow but it's inevitable. Part of that progress increases the credibility and the person sitting at home will act when they know and they have faith in you and know that the science has advanced to the point that it has. The Doppler radar will give us not just a little bit of an evolution over radar, it will be a dramatic step. There is some evidence that we will be able to identify tornado signatures in the formative stages of the tornado 20 minutes before it even appears below the cloud. That extra early warning can be really critical.

Mr. **McCurdy**. You can only cry wolf so many times. I think this helps.

Mr. **Scheuer**. Bob, I want to thank you for coming back. I do want to pass on a message from one of my staffers who is a real ski addict. He watches you religiously as the week draws near its close to get your comprehensive ski report. He asked me to ask you whether you wouldn't continue that this year up until July 4? I think it's sort of a fanatical request myself, but if it keeps him happy, I'm passing it along.

Mr. **Ryan**. He's disappointed because I announced last week was our last ski report. We have a lot of sailors so we have to start the beach and boating report some time. Thank you, Mr. Chairman.

Mr. **Scheuer**. Thank you very much for coming back to us once again with your thoughtful and lively views.

We'll now move ahead to the NEXRAD panel, the panel on the next generation of radar. I'm going to ask our four witnesses to come to the table; Mr. Anthony Durham, Director, NEXRAD Joint System Program Office; Brig. Gen. George Chapman, Commander, Air Weather Service, Scott Air Force Base, IL; Mr. Neal Blake, Deputy Associate Administrator for Engineering, Federal Aviation Administration; and, Dr. Richard Hallgren, Director, National Weather Service of the National Atmospheric and Oceanic Administration.

Normally, we set pretty rigid limits around here. I'm going to make an informal suggestion that you try and limit yourself to 2 or 3 minutes. If you feel strongly you want to talk longer, by all means do it. We've got a lot of questions for you and we're really champing at the bit to get at you in the questioning period. If you'd make some effort to wind it up in a couple of minutes, that would be nice. If you want to take the full five, quite permissible.

With that, let me call upon Mr. Anthony Durham, Director of NEXRAD Joint System Program Office.

## STATEMENT OF ANTHONY F. DURHAM, DIRECTOR, NEXRAD JOINT SYSTEM PROGRAM OFFICE

Mr. **Durham**. Mr. Chairman and members of the committee, I'm Tony Durham the director of the NEXRAD, Next Generation Weather Radar Joint System Program Office. I appreciate the opportunity to appear before you and to review the recent history of this cooperative, multiagency program and its current status.

The program has an extensive R&D foundation but can be considered to originate with an interagency concept report, published in July 1979 which collected and summarized a number of R&D studies and findings. The tri-agency Joint System Program Office representing the Departments of Commerce, Defense and Transportation was established 1 month later. An intensive crosscut analysis of agency requirements was completed for the Office of Management and Budget and published in October 1979. With the approval of OMB, the acquisition strategy adopted followed the Guidelines for Major Systems Acquisition laid out in OMB Circular A-109. An initial Mission Need Statement was approved by representatives of the Departments of Commerce, Defense and Transportation and signed by the Secretary of Commerce in August 1980.

Formal solicitation of proposals followed with the usual Commerce Business Daily announcements and a pre-proposal conference to ensure that the widest possible opportunity for competition and innovation was created. Representatives of 25 companies attended the preproposal conference. Three proposals were received in response to the solicitation from: One, Ford Aerospace/Westinghouse; two, Raytheon; three, Sperry.

All proposals were found acceptable and all three were funded for concept development studies. This was consistent with the guidelines laid down in OMB Circular A–109 to encourage wide competition from responsible bidders during the early part of the program. Cost plus fixed fee development contracts were awarded in early February 1982, with study results required at the end of September 1982.

Based on intermediate study results, a comprehensive 3-day tri-agency meeting in June 1982 re-examined cost-driving requirements identified by the contractors and all other system requirements in a concerted effort to reduce production costs. Extensive changes came out of that process and were provided to all contractors in September 1982. The concept development phase was extended by 2 months through November 1982 to allow time for the contractors to prepare revised design and cost proposals for the next phase of the program in response to the reduced requirements. The three agencies believe that the requirements defined at the completion of this de-scoping and redefinition process are sound.

The three agencies approved and the Secretary of Commerce reconfirmed the Mission Need Statement in March 1983. Validation phase contracts were awarded to Raytheon Co. and Sperry Corp. in May 1983 for development, construction, and test of competing preproduction models of the NEXRAD unit. The validation phase is divided into two parts, with the first year limited to risk and cost reduction tasks and demonstration of a part of the total system. Part 1 of the validation phase was completed on schedule and within projected costs in April 1984. Part 2 of the validation phase began in mid-May 1984, slightly ahead of schedule and will be completed in the summer of 1986.

Critical design reviews were held on schedule with both contractors between mid-February and early March 1985. Large test programs begin with both contractors at the module/subsystem level almost immediately and build to system level starting in January 1986.

Proposals for the fixed price, limited, and full scale production phases of the program are due from the contractors in April 1986. Meanwhile, during fiscal year 1985, we will arrange for field tests and engineering studies to compare the capabilities of off-the-shelf, commercially available Doppler radar against the NEXRAD requirements. Commercial Doppler radars have improved significantly in the last few years. Through a test and evaluation process this year, we will determine whether commercially-available radars can provide an adequate and a lower cost alternative to NEXRAD. We will decide which radar to buy after completion of the NEXRAD validation phase and completion of the test of commercial radars vis-a-vis NEXRAD.

Mr. **Scheuer**. Excuse me, can I ask you when will those tests be completed?

Mr. **Durham**. Which tests are you referring to, sir?

Mr. **Scheuer**. The comparisons between NEXRAD——

Mr. **Durham**. I think it depends upon a number of questions, the scope of that test program, for one thing. If it can be limited to a comprehensive analysis design review process, I believe it could be completed by late this year. If it goes on to a physical test of hardware, I believe it could not be completed before the early summer of 1987.

Mr. **Scheuer**. Thank you. Please continue.

Mr. **Durham**. The remainder of the schedule is as follows: If the NEXRAD system were chosen, a contract to the successful contractor would be awarded in fiscal 1987, and initial deliveries of NEXRAD units commencing in 1988. If a commercially available radar is selected, we will begin procurement as soon as possible.

Thank you, sir.

[The prepared statement of Mr. Durham follows:]

ANTHONY F. DURHAM
DIRECTOR
NEXT GENERATION WEATHER RADAR
JOINT SYSTEM PROGRAM OFFICE

BEFORE THE

SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURAL RESEARCH
AND THE ENVIRONMENT
COMMITTEE ON SCIENCE AND TECHNOLOGY

U.S. HOUSE OF REPRESENTATIVES

March 21, 1985

Mr. Chairman and Members of the Committee:

I am Tony Durham, the Director of the Next Generation Weather Radar (NEXRAD) Joint System Program Office (JSPO). I appreciate having this opportunity to review for you the recent history of this cooperative, multiagency program and its current status.

The program has an extensive R&D foundation but can be considered to originate with an interagency concept report, published in July 1979 which collected and summarized a number of R&D studies and findings. The triagency Joint System Program Office representing the Departments of Commerce, Defense and Transportation was established 1 month later. An intensive crosscut analysis of agency requirements was completed for the Office of Management and Budget and published in October 1979. With the approval of OMB, the acquisition strategy adopted followed the Guidelines for Major Systems Acquisition laid out in OMB Circular

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The three agencies approved and the Secretary of Commerce reconfirmed the Mission Need Statement in March 1983. Validation phase contracts were awarded to Raytheon Company and Sperry Corporation in May 1983 for development, construction, and test of competing pre-production models ("prototypes") of the NEXRAD unit. The validation phase is divided into two parts, with the first year limited to risk and cost reduction tasks and demonstration of a part of the total system. Part 1 of the validation phase was completed on schedule and within projected costs in April 1984. Part 2 of the validation phase began in mid-May 1984, slightly ahead of schedule and will be completed in the summer of 1986.

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Proposals for the fixed price, limited, and full scale production phases of the program are due from the contractors in April 1986. Meanwhile, during FY 1985, we will arrange for field tests and engineering studies to compare the capabilities of off-the-shelf, commercially-available Doppler radar against the NEXRAD requirements. Commercial Doppler radars have improved significantly in the last few years. Through a test and evaluation process this year, we will determine whether commercially-available radars can provide an adequate and a lower cost alternative to NEXRAD. We will decide which radar to buy after completion of the NEXRAD validation phase and completion of the test of commercial radars vis a vis NEXRAD.

If the NEXRAD system is chosen, a contract to the successful contractor will be awarded in FY 1987, and initial deliveries of NEXRAD units would commence 1988. If a commercially-available radar is selected, we will begin procurement as soon as possible.

Mr. Chairman, that completes my prepared statement. I will try to answer any questions that you or the other members of the committee may have concerning the NEXRAD program.

Mr. SCHEUER. Thank you very much, Mr. Durham.

Brig. Gen. George Chapman, Commander of the Air Weather Service at Scott Air Force Base.

## STATEMENT OF BRIG. GEN. GEORGE E. CHAPMAN, COMMANDER, AIR WEATHER SERVICE, DEPARTMENT OF DEFENSE REPRESENTATIVE TO THE NEXRAD PROGRAM COUNCIL, SCOTT AIR FORCE BASE, IL

General CHAPMAN. Thank you, Mr. Chairman. I, too, appreciate the opportunity to give testimony this afternoon for two reasons. One is a personal reason; it's the first time in my career that I've had an opportunity to appear before a committee, and specifically my Representative from Michigan; and, second, I would like to point out what we feel is the importance of the NEXRAD Program to the Department of Defense.

I would like to focus on it from two different aspects, sir. First of all, I'm the Department of Defense representative to the NEXRAD Program Council. Also, I'm the Commander of the Air Force Weather Service. In that capacity, I have a responsibility to provide service worldwide to Air Force and to Army installations.

One of the most important services that we have is the issuance of warnings that give lead to severe weather. We have to provide those to the decisionmakers and timeliness is a key factor and key to that timeliness is an effective radar system.

Obviously as you can relate from your own circumstances, these warnings allow aircraft to be hangared or diverted to other bases, resources to be protected, and people to take safety precautions. Timeliness is a key word and we have to give generally a 1-hour leadtime to allow those warnings to be effective for those decisionmakers. In 1984, we issued 18,000 such warnings worldwide; that's a big responsibility and, again, radar is key.

How do we stand in that regard at the present time? The network of radars that we currently have in the Air Force Weather Service were fielded in 1964, with 1950's technology. We do have some exceptions to that. They're not newer; they're older. We have one at Fort Sill, OK that was fielded in the 1950's. It's really an airborne radar out of an aircraft that's been modified and that's our present capability to provide warning service in that area.

We have an old outdated system. NEXRAD is going to give us the capability to upgrade that in many different ways.

Second, and I think just as importantly, through the auspices of the NEXRAD Program, we're going to be able to share data as OMB recommended back in 1979. We can share with the National Weather Service; share with the FAA; and in that fashion, reduce the overall cost but, even more importantly, plug up some of the holes that we have.

At the present time, I've got a requirement for 120 radars in my service. I have 88 at the present time. Under the configuration of a NEXRAD Program, we're going to be able to plug up those holes and more effectively, certainly cost-effectively and more efficiently, provide the service that we need.

Just as important is the consideration of manpower. We find the NEXRAD Program is explicitly tailored to our manpower requirements, both in terms of the type of people I have, and I mean that in a favorable sense, and in terms of their training capabilities. Over half of my people that will operate these systems are journeymen or apprentice operators. That insures that the system has to be tailored to those people and to the numbers of people that we have, as well. NEXRAD Program has certainly met that need.

If you talk about the value of that program, that certainly becomes key with respect to the capabilities that we have today. We find that the NEXRAD Program, by the very nature of the system that it has and the service that it renders, is able to double the detection rate of severe weather, that is weather having 50-knot winds or having hail with a thunderstorm. There are many other applications. In that one instance, it's going to double the detection of that particular storm or that particular feature.

For us in the military service, in particular, where we're trying to give people warnings that will minimize wasted time, false alarm rates become very important. In other words, if I can give a warning and have assurance that that's going to verify so someone won't cancel a training mission, that becomes very important. The NEXRAD system is going to reduce by a factor of three those false alarms.

Third, from a value point of view, tornadoes are havoc wreaking to all places in the country. It's important that we be able to protect and give warnings. With the NEXRAD system, we're able to increase the warnings on tornadoes from zero, with the present system, to 20 minutes. I think the value of that was demonstrated to us during the prototype development in 1979 at Vance Air Force Base in Oklahoma. Our radar was inoperative, and we were able to use that prototype network to give the forces at Vance sufficient time to hangar the aircraft and to avoid 70-knot winds which hit that base with golf-ball-size hail. It could have wreaked damage on a very valuable resource if that had not been taken.

So to us, both from a standpoint of the capability that we have at the present time, and from the upgrade which is certainly going to be affected through NEXRAD, this is an essential program for us. We feel it's going to give us the capability that we need and any further delay in acquiring this program, for any reason, does concern us. It concerns us because the high cost of maintaining what we view as an already unreliable system, will continue to increase and our service to the Department of Defense will be further decreased, quite frankly.

We've had many situations in the past few years where our radar has failed, that which we have at the present time, and timely warnings were not able to be given. It's happened throughout the country, it's happened in Washington, DC; it's happened in Oklahoma, North Carolina, and at our installations throughout the world. Obviously, we want to be able to avoid that. That's our responsibility and that's my responsibility and that's why the timely acquisition of NEXRAD is very important to us. We've continued to support that program since its inception in 1979. We've committed $20,000,000 to the program, and we continue to support it strongly. We ask for continued support for what we feel is a nationally important endeavor, not just to the Department of Defense, but to the Department of Commerce and the Department of Transportation.

Mr. Chairman, I do thank you again for this honor and the opportunity to comment before you on this program. I'll be pleased to answer any questions that you may have at a later time, sir.

[The prepared statement of General Chapman follows:]

DEPARTMENT OF THE AIR FORCE

PRESENTATION TO COMMITTEE ON SCIENCE AND TECHNOLOGY,
SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE
RESEARCH AND ENVIRONMENT,
UNITED STATES HOUSE OF REPRESENTATIVES

SUBJECT: THE NEXT GENERATION WEATHER RADAR (NEXRAD)

STATEMENT OF: BRIGADIER GENERAL GEORGE E. CHAPMAN
COMMANDER
AIR WEATHER SERVICE
DEPARTMENT OF DEFENSE REPRESENTATIVE
TO THE NEXRAD PROGRAM COUNCIL

21 MARCH 1985

NOT FOR PUBLICATION UNTIL RELEASED BY
THE COMMITTEE ON SCIENCE AND TECHNOLOGY,
SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE
RESEARCH AND ENVIRONMENT, UNITED STATES
HOUSE OF REPRESENTATIVES

Mr Chairman and members of the committee, thank you for the opportunity to appear before you today. I want to tell you how important the Next Generation Weather Radar (NEXRAD) is to our weather support function, how the Department of Defense (DOD) plans to employ NEXRAD, and how urgent it is for us to obtain NEXRAD.

## THE IMPORTANCE OF NEXRAD

### The Need for NEXRAD and its benefits

Severe weather threatens military installations and hampers operations daily. Both the Naval Oceanography Command (NOC) and the Air Weather Service (AWS) provide weather warnings to installation commanders and forces worldwide. These warnings must be timely and accurate to avoid unnecessary losses due to either a lack of lead time or false alarms. Weather radar is the primary tool for detecting severe weather.

DOD's currently deployed radars were designed and deployed in the early 1960s. Using conventional or non-Doppler radar, our weather forecasters can only infer the impending or actual occurrence of severe weather since the radars only detect precipitation. These aging radars also present maintenance problems. They require constant attention and, when they fail, parts are either difficult to obtain or must be reverse engineered. In 1981, we removed five operational radars from the inventory just to support a depot overhaul program to insure a continuous rehabilitation program. Furthermore, we currently have only 88 operational radars deployed to satisfy 120 documented requirements in the Air Force alone.

In the early 1970s, we recognized the need for a new radar capability. We needed to be able to detect severe weather, not just infer its existence. Our technical experts recognized the value of Doppler technology, and we embarked on a program to procure an advanced weather radar, targeting 1980 for a new operational capability. The Air Staff validated this requirement in 1977.

Following a cross-cut study by the Office of the Federal Coordinator for Meteorology in 1979, the Office of Management and Budget, requested that the DOD participate in the program now called NEXRAD. We have strongly supported NEXRAD ever since that time.

The Joint Doppler Operational Project, conducted in Norman, Oklahoma, in 1977-1979, clearly demonstrated that NEXRAD would satisfy our requirements for an improved severe weather detection capability, and it set the baseline for system performance characteristics. NEXRAD also provided the opportunity for DOD to gain significant cost savings compared with previously conceived plans. An Air Force Systems Command cost estimate completed in 1981 indicated that the Air Force would have to spend over $400 million to develop its own capability. NEXRAD provided the participating Departments the opportunity to share development costs to satisfy common requirements.

## NEXRAD EMPLOYMENT

Through its embedded automation, a networked doppler radar system, such as NEXRAD, affords participants the ability to distribute tailored products to more than one user from a common antenna system. Such a system will allow us to share data from National Weather Service (NWS) and Federal Aviation Administration (FAA) systems. For example, in the Washington, D.C. area, we plan to install one radar at Sterling, Virginia, with remote displays located at Andrews AFB, Maryland, and Leesburg, Virginia. Similarly in the Oklahoma City area we will position one radar near Norman to support the NWS office, the FAA control center, and the massive Tinker AFB complex. A shared data system permits considerable savings because rather than buying 120 radars just to satisfy AWS operational requirements, we need to buy only 39 radars and 81 remote displays. Procuring the additional 81 radars rather than remote displays would nearly double our procurement costs as well as increase our maintenance manpower cost $40 million over 20 years, assuming only one additional maintenance person per location.

### Automated Products

The embedded automation combined with Government furnished algorithms allows the system to produce radar products rather than just raw data. Unprocessed Doppler radar products are difficult to interpret, even for a highly trained radar meteorologist. We must have a system which our journeyman (5-level) enlisted forecasters can use. DOD NEXRAD products, which are currently being developed and tested at the NEXRAD Interim Operational Test Facility in Norman, Oklahoma, will permit our present forecaster force to use the Doppler capability without requiring us to increase either manpower or skill levels. If automated products are not available, we project not only an increase in skill level requirements, but one to two additional manpower positions at each location.

### Supportability

NEXRAD is designed to be a highly reliable system which will be maintainable by AF journeyman maintenance personnel. We must rely on military maintenance overseas and therefore must have a support base of military maintenance personnel at stateside locations. The system will come with technical orders, and all spare parts will be dual sourced to reduce life cycle costs. NEXRAD reliability and maintainability will be greatly enhanced through built-in test and on-line diagnostics.

## NEXRAD URGENCY

### We Can't Do Our Job

The DOD needs NEXRAD today. None of us in the DOD weather services can adequately provide the operational weather support our customers need. Our current fleet of weather radars is old, hard to maintain, prone to frequent failure, and cannot reliably detect severe weather phenomena. The already demonstrated capabilities of a NEXRAD system satisfy not only our technical requirements but will do so with no need for manpower increases nor for significant additional training of our basic forecaster force.

## Examples of Deficiencies

NEXRAD could have prevented damage to numerous VIP aircraft at Andrews AFB in August, 1983, when winds in excess of 120 knots caused $500,000 damage. No warning was available because of an inoperative radar. In July 83, undetected high winds from a thunderstorm caused $60,000 damage at Minot AFB--inoperative radar. Thunderstorm wind gusts caused $100,000 damage to aircraft and facilities at Fort Bragg in Aug 83--again, an inoperative radar.

## Committed to NEXRAD

DOD will have already invested $20.0 million through fiscal year 1985 to obtain NEXRAD. The Air Force and DOD have continued to fully support all required out-year funding. We have requested $5.6M in development and $4.2M in production funds in fiscal year 1986.

## CONCLUSION

We in the DOD are firmly committed to providing the best weather protection for our national resources at the lowest possible cost to the nation. Our strong support of the NEXRAD program is a manifestation of our commitment. We cannot withstand any further delay in this program. NEXRAD will improve the DOD Weather Services' ability to perform their missions and provide the DOD a reliable, capable, and responsive weather radar system.

Mr. **Scheuer**. Very good, General. We're delighted and honored to have you here and to take time out from the heavy pressure of your duties and your mission. That goes for all of the witnesses. We're all honored to have you here.

Now, we'll ask Mr. Neal Blake, deputy associate administrator for engineering, Federal Aviation Administration.

## STATEMENT OF NEAL BLAKE, DEPUTY ASSOCIATE ADMINISTRATOR FOR ENGINEERING, FEDERAL AVIATION ADMINISTRATION

Mr. **Blake**. Thank you, Mr. Chairman and members of this subcommittee. I am pleased to appear before you as a part of the panel concerning the NEXRAD Program.

Since the ability to provide timely and accurate weather information to pilots is extremely critical to our aviation safety, the FAA has a vital interest in this program.

The FAA currently obtains radar weather data from two sources: National Weather Service weather radars and FAA air traffic control radars. Data from these radars are provided to the meteorologists at our air traffic control centers and to our en route flight advisory service personnel through special digitizing equipment which is part of our air traffic control system. This data, while certainly useful, is limited. For example, only precipitation intensity is displayed by the radar. Some information on winds and turbulence is currently obtained from other sensors and reporting sources. Within a 10- to 15-mile radius around radar sites weather data on the radar display is generally obscured because of "ground clutter." Further, the flow of data from the radars must periodically be interrupted for up to 20 minutes to permit the local National Weather Service meteorologists to obtain weather height information.

Air traffic controllers can obtain some weather information from their air traffic radars, but this data is limited because these radars are optimized for aircraft detection rather than weather detection.

In order to improve hazardous weather detection, reduce flight delays, and improve flight planning, the FAA has participated with the National Weather Service and the U.S. Air Force Weather Service in the program to develop and deploy the NEXRAD system. In addition, Mr. Chairman, FAA has funded some basic research in the application of radar technology at the National Severe Storms Laboratory in Norman, OK, since the early 1970's and the results of this research have been used in the NEXRAD Program definition.

In general terms, FAA's NEXRAD requirements can be broken out into five areas: Detection requirements; signal processing requirements; weather product generation requirements; display requirements; and reliability/maintainability requirements. The NEXRAD detection requirements are such that the system will have sufficient power to detect very weak signals without precipitation, such as gust fronts, and will be able to detect light to moderate precipitation out to about 200 miles range. In the signal processing area, the NEXRAD is required to eliminate any signals which can contaminate the measurement of weather phenomena, such as ground clutter or interference from other radars, aircraft, birds, and automobiles.

The weather product generation requirements for NEXRAD are directed toward converting the basic weather measurements made at a number of elevation angles into usable products concerning hail, turbulent areas, tornadoes, and gust fronts.

The FAA coverage requirement for NEXRAD is to provide hazardous and routine weather radar data for all altitudes above 6,000 feet throughout the continental United States, except for the mountainous areas in the Western United States where coverage will be above 10,000 feet.

In addition to the kinds of weather products which will be generated by NEXRAD, we are also vitally concerned with the way the information is provided to aviation system users. Air traffic controllers, flight service station specialists, and pilots are neither meteorologists nor do they typically have time to interpret weather data which is provided them. Therefore, processed weather radar products must be presented to these users in a concise, easily understandable format.

In order to generate fully automated products, however, the basic weather radar data must be free of the kinds of contamination I spoke about earlier. The NEXRAD system, through sophisticated signal processing, is designed to assure that clean data is fed to the weather product generator. This is a critical point, since it is this very capability of the NEXRAD system to provide uncontaminated Doppler data and to generate fully automated weather products which distinguishes it from research Doppler weather radars and from the existing commercial Doppler weather radars we have seen. We will, of course, continue to monitor the development of commercial systems and software to determine their application to aviation needs.

The National Academy of Science has conducted a study related to wind shear detection and warning, and they recommended that FAA proceed expeditiously with the development and implementation of both the NEXRAD radar and a terminal Doppler weather radar for detection of these severe weather hazards.

In short, the NEXRAD system has been carefully tailored to meet the stringent kinds of requirements we must have to meet our aviation safety responsibilities.

Mr. Chairman, I second General Chapman's recommendation that we need to get on with this program. We need to implement it so that we can start to provide the types of improvements we need in the aviation weather system. This completes my prepared statement. I will be happy to answer questions.

[The prepared statement of Mr. Blake follows:]

STATEMENT OF NEAL A. BLAKE, DEPUTY ASSOCIATE ADMINISTRATOR FOR ENGINEERING, FEDERAL AVIATION ADMINISTRATION, BEFORE THE HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY, SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE, RESEARCH AND ENVIRONMENT, CONCERNING FAA AVIATION WEATHER REQUIREMENTS. MARCH 21, 1985.

Mr. Chairman and Members of the Subcommittee:

I am Neal Blake, FAA's Deputy Associate Administrator for Engineering. I am pleased to appear before you as part of a panel concerning the Next Generation Weather Radar (NEXRAD) program. Since the ability to provide timely and accurate weather information to pilots is critical to aviation safety, the FAA has a vital interest in the NEXRAD program.

The FAA currently obtains radar weather data from two sources: National Weather Service weather radars and FAA air traffic control radars. Data from these radars are provided to the meteorologists at our air traffic control centers and to our En Route Flight Advisory Service personnel through special digitizing equipment which is part of our air traffic control system. This data, while certainly useful, is limited. For example, only precipitation intensity is displayed by the radar. Some information on winds and turbulence is currently obtained from other sensors and reporting sources. Within a 10 to 15 miles radius around radar sites weather data on the radar display is generally obscured because of "ground clutter." Further, the flow of data from the radars must periodically be interrupted for up to 20 minutes to permit the local

National Weather Service meteorologists to obtain weather height information. During this time, no weather radar data is available to the FAA or other users.

Air traffic controllers can obtain some weather information from their air traffic radars, but this data is limited because these radars are optimized for aircraft detection rather than weather detection. While useful for determining areas of precipitation, these radars do not provide wind velocity or height information.

In order to improve hazardous weather detection, reduce flight delays, and improve flight planning, the FAA has participated with the National Weather Service and the U.S. Air Force Weather Service in the program to develop and deploy the NEXRAD system.

In general terms, FAA's NEXRAD requirements can be broken out into five areas: detection requirements; signal processing requirements; weather product generation requirements; display requirements; and reliability/maintainability requirements. The NEXRAD detection requirements are such that the system will have sufficient power to detect very weak signals without precipitation, such as gust fronts, and will be able to detect light to moderate precipitation out to about 200 miles range. In the signal processing area, the NEXRAD is required to eliminate any signals which can contaminate the measurement of weather phenomena, such as ground clutter or interference from other radars, aircraft, birds, and automobiles. The weather product generation requirements for NEXRAD are directed towards converting the basic weather measurements made at a number of elevation angles into usable products concerning hail, turbulent areas, tornadoes, and gust fronts. Because we expect many improvements in this area in the future, the NEXRAD radar product generator will be a programmable computer with a large amount of expansion capability. The FAA central weather processor will collect data from many NEXRAD systems and mosaic these data into one composite picture for presentation to FAA users. The NEXRAD reliability/maintainability requirements assure the system will rarely fail and that. when it does, automatic diagnostics can be used to permit repair in a half-hour or less.

The FAA coverage requirement for NEXRAD is to provide hazardous and routine weather radar data for all altitudes above 6,000 feet throughout the continental United States, except for the mountainous areas in the western U.S. where coverage will be above 10,000 feet.

Aviation weather products to be provided by the NEXRAD system include information on winds, wind shear, turbulence, thunderstorms, storm movement predictions, precipitation, hail, frontal activity, icing conditions, mesocyclones/tornadoes, and hurricanes. Meteorological algorithms exist for many of these products, and we are devoting considerable research activity into the development of wind shear and icing algorithms.

In addition to the kinds of weather products which will be generated by NEXRAD, we are also vitally concerned with the way the information is provided to aviation system users. Air traffic controllers, flight service station specialists, and pilots are neither meteorologists nor do they typically have time to interpret weather data which is provided them. Therefore, processed weather radar products must be presented to these users in a concise, easily understandable format. Center weather service unit meteorologists also require fully automated weather radar products, particularly since they may be responsible for weather coverage in several states serviced by 25 or more weather radars. To accommodate this need for automated weather radar products, we are incorporating the capability to mosaic all weather radars within a center's coverage into one composite picture.

In order to generate fully automated products, however, the basic weather radar data must be free of the kinds of contamination I spoke about earlier. The NEXRAD system, through sophisticated signal processing, is designed to assure that "clean" data is fed to the weather product generator. This is a critical point, since it is this very capability of the NEXRAD system to provide uncontaminated Doppler data and to generate fully automated weather products which distinguishes it from research Doppler weather radars and from the existing commercial Doppler weather radars we have seen. We will, of course, continue to monitor the development of commercial systems and software to determine their application to aviation needs./

In short, the NEXRAD system has been carefully tailored to meet the stringent kinds of requirements we must have to meet our aviation safety responsibilities. As NOAA conducts its review of the NEXRAD program, we expect to closely monitor their efforts to assure that our aviation weather needs are fully met.

That completes my prepared statement, Mr. Chairman. I would be pleased to respond to any questions you might have at this time.

Mr. SCHEUER. Thank you very much, Mr. Blake.

Now, for the last witness, Dr. Richard Hallgren, Director of the National Weather Service of the National Atmospheric and Oceanic Administration.

## STATEMENT OF DR. RICHARD E. HALLGREN, DIRECTOR, NATIONAL WEATHER SERVICE [NOAA]

Dr. HALLGREN. Thank you, Mr. Chairman. I would appreciate it if the full text of my testimony could be included in the record.

Mr. SCHEUER. Yes, well that goes for all of the witnesses. The full text of their prepared testimony will be placed in the record.

Dr. HALLGREN. Severe weather and flash floods in this country are an enormous problem. If you think that in this country we have up to about 1,000 tornadoes a year, in Europe they probably have up to 10. In China, they always have less than 10. If you think that across this Nation every year, literally every State has at least one or more flash floods; in Europe it's rare that they have any flash floods. If you think of the number of tornadoes that affect this country, if you think that we have tens of thousands of thunderstorms, you very quickly realize that providing warnings for the safety of the people of this country is extremely important.

The weather radar network that we have is the backbone of the technology that's needed to provide the necessary severe weather and flash flood warnings. In fact, a recent study indicated that three out of four of the warnings that are issued in this country are motivated by radar observations.

Our present network consists of 56 radars which are staffed around-the-clock. Forty-five of these radars are over 20 to 25 years old, and obviously in need of replacement. We have 11 that we've put in in the last decade in order to try and replace those that are already worn out. It's very clear that we have to replace the radar network across this country.

Furthermore, we have, as a result of the science and technological advances of the last decade, a real opportunity to not only replace the radars that we have, but to make them far better in the warning process.

In the last decade we've had the Doppler capability come along and we now can get far better information, more precise information, as to exactly where tornadoes are forming, the intensities of the thunderstorms, the outflows from thunderstorms that are needed in the aviation area, et cetera. Also, we have the capability now with the overall radar technology to get much more accurate quantitative measurements of precipitation, which is absolutely vital whenever you're trying to issue a flash flood forecast or warning and trying to carry out more effective water resource management.

In general, we have to replace the radars because they're old and we should replace them with the capabilities that our science and technology allows us to put into place. We've been testing these types of capabilities out at our National Center for Atmospheric Research and our Environmental Research Laboratories both in the Boulder area and in the Oklahoma area. Whenever you bring together the radar information and the satellite information and all of the conventional meteorological information, you see very clearly that you can increase the accuracy of the warnings, and you can decrease the area that is covered by a warning, and that is absolutely vital if we're going to get the people to listen to the warnings and take heed.

We believe that we, in the Weather Service, are on a track now where we have already set in motion parallel efforts that modernize and restructure the National Weather Service to integrate the advanced radars that are now possible, the satellite information, automatic surface observing stations through the AWIPS-90 Program, and have the data and products readily accessible to our meteorologists and other external users in the 1990's and beyond. We'll have a much better warning system across the whole country if we do these programs. Thank you.

[The prepared statement of Mr. Hallgren follows:]

STATEMENT OF
RICHARD E. HALLGREN
BEFORE THE
SUBCOMMITTEE ON NATURAL RESOURCES, AGRICULTURE
RESEARCH AND ENVIRONMENT
COMMITTEE ON SCIENCE AND TECHNOLOGY
HOUSE OF REPRESENTATIVES
March 21, 1985

Mr. Chairman, and Members of the Subcommittee:

I am pleased to have this opportunity to provide information on the radar program of the National Weather Service (NWS).

I would first like to describe the importance of our weather radar network in the United States for severe weather and flash flood warnings to protect the health and safety of our citizens. I should stress that the current weather radar network is the backbone of our entire severe weather warnings program, including flash floods and hurricanes. Recent verification studies have shown that the field staff of the NWS are highly dependent upon radar as a source of information. Impressively, these studies also show that approximately three out of four of overall storm warnings are motivated by radar observations. Radar and satellite estimates of rainfall are also crucial in providing our populace with timely warnings of flash floods, especially over the Appalachians and Western U.S. where surface measurements are sparse.

Implementation of the current weather radar network began during the late 1950's. The primary weather radar network is now about 20-25 years old and consists of 45 WSR-57 radars, combined with 11 newer solid-state WSR 74S radars using 1970's technology. In addition to these 56 radars which are staffed 24-hours per day, the Weather Service makes use of the FAA Air Traffic control radars in the Western States for limited weather information, and operates 72 gap-filler radars also procured and installed since the 1970's.

In the 1970's, we moved toward more quantitative application of the radar network by using manually digitized radar data to provide more accurate and frequent rainfall estimates over the country. More recently, we developed a pilot program, called RADAP II, which has brought fully automatic, computerized digital radar estimates of rainfall and storm characteristics to 10 of our radar sites. The use of radar processing technology in RADAP II has given our forecasters additional skill in accuracy and lead times for severe thunderstorm warnings and in precipitation forecasting. The majority of our radar stations, however, still use manual data extraction procedures. In summary, the current radar network has saved thousands of lives and hundreds of millions of dollars through its dominant role in the warnings and precipitation forecasting process over our country. Nevertheless, we believe that substantial improvements in tornado warnings and precipitation forecasting will arise from early national implementation of Doppler radars.

Doppler radar technology was first demonstrated in 1972 as an important tool for detecting storm patterns. As accurate and timely as our current severe weather warnings are, we find that we have an 80 percent false-alarm rate (i.e., "cry wolf" about 80 percent of the time) based on radar-generated warnings. Since the demonstration of Doppler radar as a practical storm warning tool, there have been other important related technological advances. We are all familiar with the rapid trend towards more powerful, economical microcomputers with increased storage. The Doppler weather radar produces more than three times as much data flow as a conventional radar, and the usefulness of this information to a forecast is dependent to a large degree on the speed, capabilities, and resolution of the combined radar and computer processing system. Derived products have recently been developed by the research community to automatically and reliably detect and track severe thunderstorm phenomena, including tornadoes, hail, and damaging windstorms. Another recent breakthrough has been the use of powerful Doppler radars to map the winds in the optically clear boundary layer. This allows the forecaster to clearly track cold fronts, thunderstorm outflows, and gust fronts.

These additional Doppler capabilities have been made possible by faster, smaller processors, as well as improved displays and computer software. Most important, these recent advances in Doppler technology have been operationally demonstrated in field experiments at NOAA's Environmental Research Laboratories and the National Center for Atmospheric Research. The results have been very encouraging. Through the combined use of information from radars, satellites, and conventional meteorological stations, the probability of detection of severe weather and flash flooding has been substantially increased, and the area covered by each warning has been decreased. During a 1984 winter NEXRAD demonstration in the Boston area, our forecasters had remote "live" displays from the 10 cm Doppler radar at the nearby Air Force Geophysics Laboratory. These wind profiles proved to be very useful in forecasting winter storms over the Northeast, and in particular, the changeover from rain to snow — a critical, yet vexing forecast problem.

The recent advances in radar, computing, and display technologies will permit us, for the first time, to produce frequent, accurate maps of rainfall over the entire U.S. Obtaining accurate estimates of precipitation is of enormous importance, but is one of the most difficult of all meteorological parameter estimation problems because of the large variability in precipitation that occurs over very short distances and short time intervals. Forecasters or hydrologists need accurate estimates over small-to-medium size watersheds for flash flood warnings, but these cannot generally be obtained in real-time from rain gages alone. The best approach to precipitation estimation on an areal basis is through the use of quantitative, high-resolution weather radars combined with a limited number of rain gages for "ground-truth calibrations." The capability to produce accurate, frequent rainfall maps for our river basins, which is within our reach now, will lead to much improved flash flood warnings, to flood loss reductions, and better information for water resource management.

Finally, these exciting new technological developments will allow us to build on the radar observing experience of our staff over the past 25 years. We will be automatically processing and displaying the wealth of information contained in the reflectivity and Doppler radar data. We already have set in motion parallel efforts at modernizing and restructuring the NWS to integrate the advanced radar, satellite, and ASOS data through the AWIPS-90 program, and have the data and products readily accessible to our meteorologists and other external users in the 1990's and beyond.

Mr. SCHEUER. Thank you very much, Dr. Hallgren. Congressman Dave McCurdy.

Mr. MCCURDY. Thank you, Mr. Chairman. I want to commend each of the panel members for their statements. Mr. Chairman, I haven't been in Congress nearly as long as you, but in 5 years, that's probably as good no-nonsense statements as I've heard. They cut out a lot of the rhetoric; they got to the meat of the issue; Mr. Durham outlined the concerns with the contracting, the development; we're online if we stay there, if we get off schedule, we can develop some problems, and that's what I'm concerned about. General Chapman outlined a lot of the areas and concerns within the military. I might add one personal observation. In 1981, a tornado hit Altus Air Force Base in Oklahoma and did about $50 million worth of damage to buildings. One interesting thing was that two C-5 Galaxies were literally picked up and thrown into each other. Those are $50 million airplanes. Had we had better notice, we could have had those birds in the air and away from that field and we could have minimized some of the damage there. I think the importance to the military can't be stated enough because of the vast resources and assets that we now have in some of our sophisticated military equipment. We need to be able to predict it better and, with 20 minute warning time, we can move some valuable assets.

The concern I have, and I think we have a series of questions that we want to get to, but I want to get to the heart of it. I'm going to ask General Chapman and Tony Durham first.

Mr. SCHEUER. Excuse me. Let me just make a remark before you ask your questions. We have a lot of questions, so I would urge the witnesses and my colleagues to keep both the questions and answers short so that we have time to throw all the questions at you that we have in mind.

Mr. MCCURDY. The question comes up, and I think Mr. Henry raised it, that the bottom line issue here is not whether we go to a Doppler radar, but, in my understanding, there's a difference between the NEXRAD and just a regular Doppler radar and that there's a concern that maybe we can go to the Enterprise system which some weather stations have, and get a commercial off-the-shelf weather system. My question is would that satisfy the requirements that you have within the Air Force and Mr. Blake at FAA can answer that, also. Do you believe that with the specifications that you've written in of the specific requirements that you have, would commercial off-the-shelf radar meet those requirements?

General CHAPMAN. Your question implies an answer as to available right now. Off the shelf, I interpret as something that I can go out and buy now and have the same capability within the same timeframe that the NEXRAD Program would give me. The answer to that clearly is no from what I understand at the present time. There's some very salient considerations in NEXRAD that are not just attuned to us, but attuned to the other agencies. I'm not aware of any imbedded automation in an off-the-shelf radar system that will allow products rather than raw data to be, if you will, provided to our people. Our people are very well trained; I'm very proud of them. By the same token, as I indicated earlier, over half of them are journeymen or apprentice operators. We try to tailor the products so that they'll be able to interpret them and provide those warnings.

The NEXRAD Program will do that; off the shelf will not. Off the shelf, furthermore, will not provide us the network kind of capability that is presently a part of that NEXRAD Program. That's not in an off-the-shelf system, which means I would have to procure more systems and probably have to ask for a greater number of people to take care of the systems that would be procured off the shelf. There's really no simple answer to that but those are two of the salient considerations that I would ask you to consider.

Mr. McCurdy. Does anyone care to amplify that from their agency? Mr. Blake, how does the requirement for FAA, I guess specifically wind shear, affect——

Mr. Blake. There is a number of requirements in the joint operation requirement that were put there to meet aviation safety's specific needs. Some examples of that are there's a need for rapid update to get information on the movement and formation of severe weather conditions within a matter of a minute or two. We need the processing horsepower to produce not only the raw data, but some 24 weather products specifically tailored to the needs of the meteorologists, the controllers, and the pilots.

We need to have built-in test capability within the equipment. This is tied to a requirement for a very high level of availability. We cannot afford to have these radars inoperative during a period of storm conditions, particularly in and around the high storm areas, high traffic areas of the country. A failure there inevitably means exposure of some of the flights to possible unsafe or hazardous weather conditions.

In addition, we require good performance from the radar and this means the ability to detect some of the phenomena which are, if you will, clear air phenomena, which are very low signal phenomena like the microburst, which represent an extreme hazard.

Mr. McCurdy. May I interrupt you on the performance. Would you list on the performance as far as fidelity, the range, the network capabilities, the clutter rejection, the speed of coverage, the speed of data handling, those kinds of performance questions. Are those specific things that you believe NEXRAD can address that off the shelf are questionable?

Mr. Blake. That's correct. We have built into NEXRAD a great many years of research, some at the National Severe Storms Lab that we have funded jointly with others. We have, of course, taken into consideration technology that was available before joining up with the other agencies in a joint development. You mentioned one of the very key ones which is elimination, to the extent possible, of ground clutter in and around the radar. This is particularly important to us because many of these radars are located near a major terminal and we very much need to see the weather in the vicinity of those terminals.

Mr. McCurdy. You've discussed performance and reliability. General Chapman was discussing the degree of automation. What about the documentation of the software, the maintainability, and lifetime system costs, which is really important when you're talking about the overall cost of the system, flexibility, and availability.

Mr. **Blake**. You've touched on most of the key points. One of the costs that's quite often overlooked is the cost of the maintenance manpower. I think the human resource these days gets to be an extremely expensive one and we are in the process throughout FAA of going to remote maintenance monitoring of all of our equipment to reduce the manpower needs, and through requesting and requiring and specifications, we are able to keep our equipment on the air a much higher percentage of the time than we used to be able to with far fewer people. That's a very important consideration.

Others, having a joint program—we are able to go to common logistics, common stocks and stores, common training. So, there are a number of savings in the life cycle cost area that can be identified.

Mr. **McCurdy**. Dr. Hallgren, do you have any comments?

Dr. **Hallgren**. I'll try to be very brief and say that I have a slightly different problem than General Chapman. It's not that we have journeymen people, it's the number of people that we have. In the NEXRAD system, we've been trying to design this and set the specifications such that we will be able to maintain the larger number of radars with the same number of technicians. That's very important to me.

Second, we've been trying to get so that we have enough automation in the system, so that we will not have to dedicate people totally to monitoring the radar and developing the hourly reports and half-hourly reports. We are trying to get so that we can work on an integrated basis in the station, and the people will be working on many jobs, a lot of which will be the radar. That requires us to have a high level of automation. Of course, reliability is absolutely essential. Bob Ryan complained here about some of our charts coming out with radars down for maintenance. I don't like that. He doesn't like that and more seriously, the people that don't get the warnings don't like it. It's important we have a high quality radar.

Mr. **McCurdy**. How often are they down for maintenance? Is this a common occurrence?

Dr. **Hallgren**. We invest a lot of time in keeping the radars going and the older they get, the more time you invest. We still keep those statistics looking fairly good but it's getting more and more challenging each passing day.

General **Chapman**. If I could amplify on one comment that was given. I didn't quantify actually the impact in terms of people that an off-the-shelf system would mean to us. If, on the current basis, we would receive raw data in a station vis-a-vis tailored products that the NEXRAD Program has, what that would mean, in our case, is two more people per each station at which we have a radar. That's a tough manpower cost for us to be able to handle at this time or at any time.

Mr. **Scheuer**. Let me just ask you to elaborate on that. When you're doing the cost effectiveness comparisons, will the fact that you need more of the off-the-shelf systems and more personnel to manage the off-the-shelf systems that are not as well automated, will those additional operating costs and capital costs be factored into a sophisticated cost-benefit analysis of the long-term life cycle costs of the two systems?

General **Chapman**. Yes, Mr. Chairman. I would think they should be and they would be if that were requested. I can give you a good example in that case. For our situation in the Department of Defense, through this triagency program where we can share data in a more cost-effective way, we will require 39 principal radars and 81 remote systems. They still will give us a capability but if we did not have a shared program, then we would have to procure 81 additional full-up systems unless there were a full network. That's a considerable cost investment on our part and one that we would not be prepared to undertake at the present time.

Mr. **Scheuer**. Let me ask you another general question about all this. General, I think it was you who said that the NEXRAD system was explicitly tailored to the needs of the Armed Services. We've seen a defense cost system that's absolutely run amok, that's out of control. We've seen interservice rivalry produce utter waste and chaos. The Army, Navy, Air Force, and Marines can't use each other's airplanes, they each have to design their own special mission aircraft. They can't use the same socks, the same boots, the same raincoats, the same matters of ordinance, right down the line. There seems to be something so special and unique about the needs of the Army as against the needs of the Air Force, the Marines, and the Navy, and vice versa. This is ordinance specifically tailored, etc. to the ridiculous and absurdum, to ridiculous extremes.

I know this committee wants to do right by you and we want something that is explicitly tailored to the needs of the Armed Services and to the needs of our defense; the sophisticated long-term weather forecast that proved to be so helpful in the Falklands war. We don't want it so explicitly tailored that it's silly. Will you explain to us—is this explicit tailoring that you talk about based on commonsense and real need or is it just based on a lot of institutional egos at work that are just going to cost the taxpayers untold hundreds of millions of dollars of extra money that could just as well have been served by equipment that's off the shelf. And, I ask that as the devil's advocate.

General **Chapman**. I appreciate the opportunity to respond to that. Let me tell you why I used the term expressly tailored, if you would, to our requirements. If I may, I'd like to give you very shortly a little background on some of our people. When I refer to the fact that over half of our people are apprentice or journeyman operators, here's basically what I mean. A large portion of my force are enlisted people who enlist out of high school. We send them to a short training school in Illinois for approximately 14 weeks and within a couple of years after that, we send them to one more 20 week school. At the end of that time, they have journeyman qualifications. That's with roughly 32 weeks of training. What they're prepared to do at that time, sir, they're not fully qualified meteorologists in a professional sense. They do not have degrees from college, but they're trained to be able to work with the requirements of a system. When we sat down as a triagency a few years back and looked at the requirements within this program, one thing that was very important to us was that the imbedded automation within this system would provide the type of products that Mr. Blake referred to that would allow our operators to work with this system in such a way that we could meet our requirements in the most cost-effective way possible. That's what I meant by that statement, sir, and I feel it is still accurate and that is what we needed out of NEXRAD.

At the present time, I'm not aware that that would be provided through any off-the-shelf system.

Mr. SCHEUER. I'm really pleased that all of the users seem to have gotten together here and to have designed one single standard set of specifications for the NEXRAD system. I take it that there's not such a difference in sophistication and training of the personnel.

General CHAPMAN. My colleagues would attest to that. We've worked very closely in this area and we feel it's compatible with all our service or agency requirements.

Mr. SCHEUER. Bob Smith.

Mr. SMITH. One of the things that pops up frequently in the various budgets in this area and a lot of the areas that this committee deals with is the problem that there is involvement by DOD in some of these areas and sometimes it becomes sensitive and it's very difficult to deal with it in the budgetary process. Maybe it's the process itself that's the problem. For example, in the ocean mapping, we received testimony earlier that there was some concern about making that kind of information public because of security reasons. We're also having problems in terms of the space situation; how much of that shuttle ought to be shared by DOD, what ought to be shared by the other Departments, the NASA and so forth. We're looking at the same thing here with the NEXRAD thing. I think you have approximately 20 percent as your ratio. How do you resolve these things? Are we boiling these things down into interdepartmental jealousies that are going to hurt us in terms of providing an overall U.S. policy for the space program? An overall policy for mapping the oceans? An overall policy for having the appropriate effort for NEXRAD? It just seems that there are going to be times when there is conflict. I think this is one of them and there are others. I would appreciate your comments on it and we had an experience this morning in another budget hearing about the shuttle. Essentially is the military going to pick up part of that expense or how much of it or not. It's very frustrating in terms of where to put the money. Maybe it's just an academic point because as long as we put it, I think it certainly impacts, especially if the private sector gets involved in some of this where it obviously cannot in the area of defense.

That's a long question I know, but I——

General CHAPMAN. I believe you directed that question to me and I could respond this way. In terms of are we getting into any involved areas where we have major disagreements that impede all of the organizations from doing what they should do to meet their requirements? I have been a member of the NEXRAD Program Council now for approximately a year, and have had the opportunity to work with my colleagues longer than that, however, I think that we're in full agreement on what this program means to our individual agencies and, therefore, if we talk about the agencies, we're talking about the nation as a whole. I think we're in harmony on that and in terms of the DOD commitment to this program, the $20 million that I referred to has been committed through fiscal 1985 because we feel very good about the things that it's going to do for the Department of Defense and for the Nation in terms of protecting our resources.

Mr. SMITH. Is 20 percent of that figure—would the other gentlemen agree that's a fair share for DOD and another 20 percent for DOT compared to 60 percent for Commerce?

General CHAPMAN. I'd like to defer to them to answer that, or perhaps to the Director of the program, Mr. Durham.

Mr. DURHAM. The 60/20/20 percent allocation that you referred to applies only through the development phase of the program. We're now in the final stages of negotiating the percentages for the production phase and they would be tailored to the equipment that is supplied to each agency. There is significant content of shared costs even in that process. The joint program does result in fewer radars being required and, as a result, all three agencies do share in the benefits of that joint program.

Mr. SMITH. Thank you.

Dr. HALLGREN. I've been on the NEXRAD Program Council since its beginning and I would like to say that we've been trying to be very careful with the requirements. We've always been trying to look at the cost drivers in the program very closely to try and hold the requirements down just as much as possible. Quite frankly, the DOD people have not been in one of these modes where you try and get the most fancy system, and furthermore, I wouldn't have allowed it because the Weather Service is accustomed to working with small budgets.

Mr. MCCURDY. Would the gentleman yield? I would just like to make a statement. I think the gentleman asked a very good question and sitting on the Armed Services Committee and also the Select Committee on Intelligence, I see a lot of programs where I think that there is an interservice rivalry and the one hand of the government failing to communicate with the other hand. As a matter of fact, I think the Landsat system is a classic example. We're about to blow away a $1 billion investment that the U.S. Government made in developing Landsat because of the failure of OMB to approve a contract to go commercial because of what they considered to be a subsidy and we're going to end up having no system whatever, and buying the information from the French and the Japanese for the system we developed because of this failure to understand it. I found that, in the Department of Defense, only too late, after Mr. Stockman got involved, that they were so jealous of their particular systems, that, even though they were users, they weren't communicating that to the Department of Transportation, I mean, the Department of Commerce.

I think that it's important that we stay on top of that and pursue that line of argument. In this case, and I would make an invitation here to you, I have the rare opportunity to work with the three agencies here. FAA is right in my district, I have the Air Force, and we have the National Severe Storms Laboratory doing the research for NEXRAD, all in my district. I would like for you to have the opportunity for you to come out and visit that. I talked to the chairman about maybe having a hearing down there to go and look at the science of this project.

I'm extremely interested, not from just a parochial standpoint, but from the fact that I sit on the R&D subcommittee and I see this waste and this inability to communicate within the government. We rarely see them working together like this, and then someone comes along and says buy something off-the-shelf which doesn't meet the requirements. That's a personal observation but I think one that we need to follow through with.

I would like to ask the panel what effect would a 6- to 12-month delay in the NEXRAD program have on each of your respective agencies?

The chairman asked a question; if we have to change the cycle of the procurement and production to allow an actual test of off-the-shelf equipment versus completed radars, in other words, have a flyoff as we'd say in the Air Force, then we're talking about 6, 12, 18, 24 months? What kind of delay are we actually talking about?

Mr. **DURHAM**. If the scope of the competition can be limited to a design review, a detailed analysis of the potential performance of the alternatives, then I believe a decision point could be reached by late this calendar year, late in calendar 1985.

In the event that we had to go through a competitive procurement process, the procurement cycle, the acquisition cycle on top of that, and then a hardware test program, it seems to me that the earliest point in time at which you would be in a position to make a decision is early summer of 1987.

Mr. **McCURDY**. With that delay in mind, what effect do you think that would have on the customers, DoD, FAA, and NOAA?

General **CHAPMAN**. I'd say first it's going to increase the cost to maintain a system that's already unreliable in terms of its ability to help us issue these warnings that I referred to earlier. Let me give you an example of what I mean. Cathode ray tubes are obviously a major part of the capability through which the radars we have today function. The three CRT's used to cost us $5,000; today they will cost us $90,000 to maintain a very expensive, unreliable system. It's a very unique system. The longer we prolong upgrading that capability, the more those costs are going to hurt us in a preventive maintenance sense.

Obviously, then if we don't have the radars, it decreases our ability to provide the warnings. I have 32 bases that have a requirement for radars and I don't have them there. Last year, at one of my bases with no radar there, we were unable to provide a timely warning and significant damage occurred to our installation there in terms of the resources. We had a radar that was inoperative in Washington, DC just a few months ago, and again, we were impacted in that regard. The longer we delay, the more we're impacted in the Department of Defense because of the inability to provide our service that we need to provide.

I think an assessment has shown that a 6-month delay would generally mean that over the next 6 years, just by delaying the acquisition of those radars the way they're programmed now, 10 of our bases would not be covered by timely radar coverage the way they're supposed to be. That would impact all of us and certainly those of us that are geared to the DOD effort. Thank you, sir.

Mr. **SMITH**. General, that problem you just mentioned with your radar, isn't part of that problem due to the budgetary process? If you had NEXRAD and it was 80 percent in DOD, it would be construed as a national security matter that you don't have these radar installations. Perhaps high priority would be placed on it in terms of a budgetary situation and you would have them. What I'm saying is, is there something being launched in breaking this thing up into these components of three different agencies like this? It's a genuine concern and I know you have it, but I'm wrestling with this thing in terms—as I said before, it's not just this issue—there are other issues. I have some concerns about it and I'm just wondering whether we're not just prioritizing the budget in the right way in terms of these items.

General **Chapman**. I appreciate your concern, sir. The way that I would respond to that is again the title of my organization is Air Weather Service, in the sense that I serve the Department of Defense. Given that we have these very important instruments, through which we carry out the mission of the Department of Defense, I have to protect those resources. The priorities, I don't have a problem with the priorities and where they lie in terms of our capability to bring that program on line. I don't think that's a problem at the present time, sir, because the Department of Defense has stood squarely behind the NEXRAD Program and it felt that it would meet our requirements completely in terms of protecting the resources that we bring on line. Have I answered that, sir?

Mr. **Smith**. Yes; you've answered the question from your point of view, and I think you've answered it honestly in terms of how you feel and how everyone feels in it. I guess I'm looking at it in terms of those of us that are looking at the budgetary process, if we felt something was detrimental to national security, we might be more inclined to leave it in the budget than take it out. Maybe there's something to that.

Mr. **McCurdy**. Secretary Weinberger seems to be very effective in protecting his budget as opposed to the other secretaries. I don't know why that is. A recent comment made after the farm vote was that maybe we ought to make Weinberger Secretary of Agriculture. We'd be a lot better off.

I understand your point, too. Just because it's under the DOD label or under its function, that it is protected as opposed to NOAA or one of the others where it gets more scrutiny from OMB.

Mr. **Scheuer**. Mr. Durham, how much time have we lost so far as a result of considering this option of testing the off-the-shelf systems?

Mr. **Durham**. Mr. Chairman, no time has been lost to this point in the program. We're on schedule.

Mr. **Scheuer**. As against going ahead with the contracting process for NEXRAD and this alternative process of having some kind of cost-benefits comparison between NEXRAD and the off-the-shelf systems, how much additional time is involved in the latter byway? Let's say we're at the fork in the road; we can either go with NEXRAD or we can go with some comparative testing. How much time would we lose with setting up some kind of serious comparison testing?

Mr. DURHAM. I believe if we go through a comprehensive hardware test of commercial off-the-shelf alternatives to the NEXRAD Program, the impact would be between 18 and 24 months delay.

Mr. SCHEUER. Can you give us some estimate of what the cost of just the delay would be?

Mr. DURHAM. At the current rate of inflation, a 1-year delay in the program with no change in the scope of the program equates to between $35 and $40 million.

Mr. MCCURDY. Would the Chairman yield on that point? I have an internal memorandum from OMB which is their proposal that NOAA had to contend with. It was that no funding was included in the Commerce and Transportation Department passbacks for NEXRAD development and procurement. They wanted the current NEXRAD Program terminated in 1985. Their contention was that it would cut funding from $900 million to $200 million by going with this off-the-shelf technology. They also made assertions that the cost of the NEXRAD Program has increased from $340 million in 1980 to $940 million in 1983. Would you please comment as to these assertions? (See appendix for OMB "passback" to the Department of Commerce in FY 1986 re NEXRAD.)

Mr. DURHAM. I'm very glad that you raised the question. I would like to clarify that point. I believe there is substantial confusion in the numbers. The costs of the program are: if you express the dollars in constant 1980 dollars, the original estimate for an all Doppler network prepared in the latter part of 1980 was $425 million; the current version of that estimate is that the number is now $460 million. There has been a growth, over 5 years, from $425 to approximately $460 million. If one expresses the program cost in real year dollars, including the effects of inflation, the corresponding numbers are $856 million for 1980, and the most recent number is $750 million, a decrease of approximately $100 million.

Mr. MCCURDY. Would someone clarify—have you put a pencil to the life cycle costs of NEXRAD versus the off the shelf, or has this been done yet, or is this something that will be forced on you by OMB later?

Mr. SCHEUER. Dave, can I just footnote that question? When he says life cycle costs, could you also factor in additional costs of maintenance of the old system, and additional costs of maintenance of the off-the-shelf system if there is such a difference, over the lifecycle of the equipment.

Mr. DURHAM. Life cycle costs are in excess of one-half of the total cost of the program over a 20 year lifetime. So, the cost of operations and maintenance of the system are the dominant components of life cycle costs. The NEXRAD system, as it is currently being designed, has made major efforts to achieve a low parts count by using common parts so that the costs of maintaining logistic support and providing training and maintenance is lower.

In addition to that, the NEXRAD system has made a major effort, as Mr. Blake referred to earlier, to provide a built-in test capability and remote maintenance monitoring capability which simplifies and significantly reduces the maintenance manpower requirements. So, the NEXRAD system is designed explicitly to minimize life cycle costs.

It's my impression that the off-the-shelf alternative has not addressed those issues.

Mr. SCHEUER. Let me continue on this line. Suppose the decision were made to go to off-the-shelf technology and suppose one of your agencies, the Defense Department for example, were to say that's not good enough for us, we're going our own way. We have to part company with you here. What would be the cost implications to the other agencies of one of the other agencies going their own way? In other words, the cost to the Federal Government as a whole if this coalition doesn't hang together, if they split over the cost of NEXRAD, and one of the services says it's not good enough for us and we're going our own way.

Looking at it from the total Federal agency point of view, what would be the cost implications of that?

Mr. MCCURDY. If the Chair wouldn't mind, is there a danger that if this thing is further delayed of your interagency cooperation falling apart in that one of the agencies be impelled to go out and do their own thing?

Mr. SCHEUER. Let me rephrase the question. What is the likelihood that any of you might want to go your own way? If one of you does, what would the total cost implications be to the Federal Government as a whole? Thanks, Dave.

General CHAPMAN. If the estimate that I give is not valid, I'll submit it for the record. I believe in our case if we were asked and directed to undertake a program by ourselves, what that would mean in our case is that rather than having for my 120 units that require weather radar to provide this service, 39 full-up radars and being dependent upon the other two agencies to share that data at 81 places, I would have to have 120 full radars. I believe that would equate to about $100 to $125 million more for us to be able to have that capability.

Mr. SCHEUER. $125 million more per what?

General CHAPMAN. Production costs to arrive at a comparable system. In that regard, the other alternative that was cited and coming back to other questions that have been asked in the same vein, it's very unlikely that we would be able to pledge an additional $100 to $125 million over the next 6 to 7 years for that kind of a capability. That's why the shared program is so important to us in the Department of Defense. And the DOD has continued to be solidly behind that Tri-Agency Program.

Mr. SCHEUER. I guess the question that Congressman McCurdy suggested as the precursor to my question is how strong is this glue binding you together going to be if you go to an off-the-shelf system that isn't exquisitely—what was that phrase—if it isn't uniquely tailored to your needs?

General CHAPMAN. It's always hard to judge the quality of glue but I would say in this case we are very strongly tied together behind this program because we recognize the alternatives to all three of our services in terms of dollar commitments and conservation of our precious resources as such that we can't afford to go it alone and come up with the same kind of capability that will be derived under this Tri-Agency Program.

Mr. SCHEUER. Yes, Mr. Blake.

Mr. **Blake**. Mr. Chairman, I might just add a thought to that. We have recently asked our system engineering contractor, Martin-Marietta, almost the same question with regard to a terminal Doppler weather radar. In their look at it, they looked at a new development, a derivative of NEXRAD, and modification of commercial radars, so-called off-the-shelf radars. Their assessment was fairly complete as to the modifications that would have to be made to existing radars and also to the fact that when one was through modifying, they would still fall short of meeting the requirement.

Their conclusion was that the nature, that is the amount of the modifications, was so significant, that it would actually be lower cost to start over with a new design. Where you had built-in features—I think so far as what do the new developments cost, the cost of the NEXRAD development is probably very representative. That was stated here at about $100 million. If we were to go our own way, we would have to each pick up at least some portion of that, perhaps all of it. Of course, since we'd each be buying a smaller number of radars, we would expect to pay more for them and we would not be able to take advantage of joint procurement of support systems, logistics costs, training costs, many of the costs which are overlooked which are very significant in determining life-cycle costs.

(Note: A draft of the executive summary of the Martin Marietta study is included in the appendix.)

Mr. **Scheuer**. Bob Smith.

Mr. **Smith**. No questions.

Mr. **Scheuer**. David.

Mr. **McCurdy**. I just would like to again commend the gentlemen. May I ask this, Mr. Chairman? Is there a representative from OMB in the hearing room? I hope that this message is being received and that you'll take a copy of this transcript because we want to send it over there to make the point clear that from what we receive and consider to be the expert testimony that this committee will be saying that we don't want you tinkering around with these programs unnecessarily, and we want to work with you to try to ensure that, in the long term, we are very sound on our judgments as to which way to go and proceed. I hope there's not going to be a compelling reason for these agencies to go their own way. I think that would be a disaster in the long run. I thank the chairman for holding these hearings.

Mr. **Scheuer**. First of all, can I ask Dr. Hallgren, no not Dr. Hallgren, Mr. Blake if you would give us that study that you just described?

Mr. **Blake**. We would be happy to do that, sir. We're doing some final editing on it and it should be available shortly.

Mr. **Scheuer**. Can you tell us what shortly is? We'd like to hold the record open?

Mr. **Blake**. I hope within the next several weeks that we can have an edited version.

Mr. **Scheuer**. Let me ask as a legal matter and we generally try and avoid these legal matters, if it's permissible for the Government to change its specifications and requirements for the NEXRAD Program at any point during the life of the program?

Can it easily and likely change its testing procedures and criteria as is being contemplated now?

**Mr. DURHAM.** I believe it's within the legal definition of the Federal procurement regulations for the Government to modify its requirements if it does it by formal process. In terms of testing, the testing is designed to prove that the specified performance is met and it is not unreasonable that the details of the test procedures would evolve over a period of time as one approaches that phase of the program.

**Mr. SCHEUER.** If you make these changes during the course of the bidding process, what allowance would you make to the two major current bidders, Raytheon and Sperry, because of the change in specifications that you're providing them and the vast amount of additional work, presumably, which they have to do?

**Mr. DURHAM.** I think you're talking in terms of the commercial off-the-shelf alternative, is that correct?

**Mr. SCHEUER.** Yes, if you add that, then they almost have—are you going to give them some kind——

**Mr. DURHAM.** It's my understanding that the three agencies are saying that their requirements are represented by the NEXRAD technical requirements. Initially the commercial off-the-shelf alternative would be required to meet, comply with the NEXRAD technical requirements. If significant changes were made, then I have to assume that both Raytheon and Sperry would be given the option to bid on those modified specifications.

**Mr. SCHEUER.** Right now you're not changing the plans and specs?

**Mr. DURHAM.** That is correct, sir.

**Mr. SCHEUER.** And the off-the-shelf bidders are going to have to meet the existing plans and specs?

**Mr. DURHAM.** I believe that is also correct.

**Mr. SCHEUER.** Your estimate, you've given us the summer of 1987, do you think that if you change—well let me ask this—right now, you think the off-the-shelf people will be able to come in with their bids and you'll be able to make a decision by the end of this year on the current plans and specs that are out there?

**Mr. DURHAM.** If we can limit that evaluation to a design review performance analysis process short of acquisition and test of hardware.

**Mr. SCHEUER.** Would either of the major bidders, either Raytheon or Sperry, have legal recourse if they didn't have time to respond adequately to changed specifications in the event you decided to change? Is anybody in the Federal Government having a good hard look at this question?

**Mr. DURHAM.** I'm not a procurement or legal expert and I'm not sure that my answer would be valid. The answer to your second question is yes, that issue is under consideration at the present time.

**Mr. SCHEUER.** Right now, I take it, it is not the intention to change the plans and specs and you're going to require the off-the-shelf people to come up with systems that meet the test of the existing plans and specs.

Mr. **Durham**. The three agencies are at this point agreed that the requirements represented by the NEXRAD technical requirements document do indeed represent their agency requirements.

Mr. **Scheuer**. I think we're about finished. This has been an extremely productive session with your panel. I want to thank you for your patience in putting up with all of these questions. Do any of you have a last word to say before we thank you and go on to the last panel?

Gen. **Chapman**. I appreciate the opportunity to appear before your committee and to present testimony on this program.

Mr. **Scheuer**. We appreciate the opportunity of having you; we know you're all busy and we're very grateful to you for taking time out of your busy schedules. We are very hopeful that there won't be a vast delay. I would think that 1½ or a 2-year delay would raise a lot of questions, cost questions, operational questions, and so forth. We'll look, I think, with a jaundiced eye at any likelihood that such a delay would be forthcoming. In any event, we thank you very much and we'll be following this very closely and we'll be in touch with you, I'm sure.

I'm going to ask unanimous consent that the record be held open for 2 weeks for members to ask additional questions and that you would be available to answer those questions. There being no objection, so ordered.

Thank you very much. We appreciate your fine testimony.

We'll now go to the last panel; Dr. James F. Kimpel, professor, School of Meteorology, University of Oklahoma, and Mr. David Miller, president of WSI Corp. in Bedford, MA.

Mr. **McCurdy**. The chairman has a commitment and asked that I chair this portion of the hearing. I, too, would like to welcome Dr. Kimpel and Mr. Miller. Dr. Kimpel, of course, is a professor at the School of Meteorology at the University of Oklahoma and a close personal friend of mine and one that I think has provided a lot of direction for the University and is one of the key science advisors for me. Not only that, as far as providing a broad range of support for the National Severe Storms Laboratories, the FAA, and the joint projects that are occurring in his area of concern, and I appreciate you taking the time to come to Washington to testify and we will give you time to present your statement and hear from Mr. Miller and then ask some questions.

## STATEMENT OF DR. JAMES F. KIMPEL, PROFESSOR, SCHOOL OF METEOROLOGY, UNIVERSITY OF OKLAHOMA, NORMAN, OK

Dr. **Kimpel**. Thank you very much, Congressman McCurdy. I am the director of the School of Meteorology at the University of Oklahoma. That's primarily an academic position, but I was also fortunate enough to serve 3 years as an operational weather forecaster with the United States Air Force. I also participated in the National Weather Service experiment recently where they put academic people in National Weather Service forecast offices in order for them to learn the operations, provide them with research support, and gain a better understanding of National Weather Service problems. I'm pleased to be asked to come and testify today on the impact of fiscal year 1986 budgets on the National Weather Service.

First, I would like to take this opportunity to thank the Congress for its understanding of NOAA and the National Weather Service. This isn't the first year that these groups have faced budget cuts and, over a period of the last four years, Congress, through this understanding, has restored many of these cuts to NOAA and to the National Weather Service.

This year, the printed budget shows that the National Weather Service can expect cuts of $15.1 million over the amount of money that it had available in fiscal year 1985. These cuts are concentrated in the areas of improved observations such as ocean data buoys and next generation radar. Also, these cuts are projected to fall on reduced staff, both at the headquarters and in the field, agriculture weather program, fruit frost programs, et cetera. In other words, things that affect the quality of the forecast and the warnings to the general public.

Cuts also fall in the area of dissemination of weather forecasts and weather warnings. Things such as the weather wire and NOAA weather radio, and this is particularly troublesome since the forecast isn't any good, or a warning useless, unless somebody has access to it.

I'm also concerned at what these cuts will do in terms of morale of National Weather Service employees. First of all, the proposed $15.1 million isn't the whole story. If you look in the appendices of NOAA's printed budget, you'll see that there are additional cuts that are to be spread throughout NOAA. These cuts amount to an additional $44.5 million. Some of these areas particularly disturb me concerning the National Weather Service. For example, there are significant cuts proposed in travel. National Weather Service must undertake travel responsibilities to maintain equipment in remote areas, to do preventive maintenance on equipment in the field, to work with Civil Defense personnel, local television people, schools, and things like that. Once a forecast or warning is issued, it must be implemented for it to have any affect.

The National Weather Service will probably be asked to absorb inflationary costs, mandated pay raises, and other things. What happens to an agency when its base is continually eroded? It responds the same way that we do at a university. What happens is that the only way you can make any kind of cost savings is to reduce personnel; maybe not on paper, but you hold positions open longer, you go through your operations with reduced staff in the field and at headquarters. What kind of things can happen in the Weather Service when there are fewer people around to do the work? The workload stays the same. Management pulls operational shifts. Some of the special programs staff, such as severe weather forecasters, agricultural forecasters, must pull regular shifts in addition to their specialized shifts. Increased overtime occurs. If you're undermanned, and you're facing a severe weather situation or flash flood situation, you might call somebody back in and you have to pay them overtime. That costs money. You begin to whittle away at other things. For example, less preventive maintenance on equipment. Costs are going to accrue from that later on. In extreme cases, you might have to even reduce your hours of operation simply to handle illnesses, annual leaves, or these vacant positions in your station.

You also spend time reducing your work with the public that helps your forecast be better implemented. We don't have a NEXRAD system now. The best tornado detection device we have is the human eyeball. In Oklahoma and other States, we must go out and recruit and train spotters and have them feed information into the Weather Service offices so warnings can be issued. We must work with the Civil Defense people. Again, the schools and local government.

Let me give you an example of what happens, and I wish Ms. Schneider was here because she referred to a report that was written after the Carolina tornado outbreak of last year. That report also pointed out that the stations in that particular part of the country were understaffed and that they hadn't done the maximum amount of work with Civil Defense agencies and other groups. What happened there is that an additional person has been transferred to cover that. That person came from Oklahoma. Now we have one less person as we approach storm season this year. It seems kind of a crazy way to run things because I guess it's whoever had the last disaster, that's where you get the staff support.

The Weather Service is a mixture of people and technologies and equipment. I would like to applaud what Bob Ryan said when he talked about now the National Weather Service is appreciated by the general public. I don't hear a lot of people complaining either. I don't see letters piling up in your office or elsewhere that the Weather Service is expensive. Very few Federal agencies touch the lives of everyone in the United States every day. The Weather Service, the Post Office, and possible the Internal Revenue Service. I think only the Weather Service is really truly appreciated by the public. I would hate to see us reduce something that they perceive as being a quality organization.

The last year that I could get figures for weather losses in the United States in 1983 amounted to $27 billion. If we used technologies that have been proved effective, acquire new equipment, and even reduce these losses by one two or three percent, they will more than pay for themselves. I'm very pleased to see some things in fiscal year 1986 budget for the National Weather Service. The development of profilers, upper-air, wind-data-gathering systems to replace weather balloons, automated surface observing system, less labor intensive data gathering equipment, advanced weather interactive processing systems. This will allow meteorologists to spend more time making a forecast. If you think about it, it's 1985. Radar is usually in a darkened room; the satellite picture is hanging on a wall; the maps and data are available on a console in front of the meteorologist. What this new system known as AWIPS will do, will allow using the latest technology, allow the meteorologist to simultaneously display satellite, radar, hopefully NEXRAD radar, and observations and forecasts simultaneously on one screen. No more running around and focus the use of his or her time to improve the quality of the forecast and warnings.

Also, the fiscal year 1986 budget includes funds for the next geosynchronous satellite. We'll be going back to where we were in the late 1970's and early 1980's when we had dual geosynchronous satellite coverage of the United States, not only monitoring the continental United States, but the adjacent oceans to the west and to the east.

I was going to say some things about NEXRAD, although I think the last panel covered it quite well. I'd like to limit my discussion to a very few things I'm concerned about. When I compare NEXRAD as planned with off-the-shelf equipment, I have a few worries from a scientific viewpoint. First of all, does the off-the-shelf equipment have the ability to detect tornadoes that are not in rain areas? All weather radars are designed to detect precipitation. If the radar is powerful enough, it can also detect motions in clear air if they're near the radar. In Oklahoma a number of tornadoes occur away from the rain area. Again, depending on distance from the radar, are these going to be as readily detectable with off-the-shelf equipment?

Doppler radar is very high technology and it's very complicated. As wind speeds increase and as distance from the radar increases, certain ambiguities are introduced. Many of these can be overcome with software. In any comparison, you must take advantage not only of the radar itself, but also the computer and the software that's been developed for that computer in order that these be as less labor intensive as possible.

Also, are both radar systems equally capable of being upgraded? These systems are going to be with us for 25 or 30 years. As new technologies emerge, can they be incorporated easily? I think it is very difficult to figure out costs or what the life-cycle costs will be to try to include this, but I do think it's something that should be considered.

I'd like to say two other things about NEXRAD. I didn't hear anyone talk about networking NEXRAD and the idea of providing input into flash-flood models and water management activity. One of the very nice things we're going to be able to do with NEXRAD is estimate rainfall extremely accurately in the vicinity of that radar. This is something we've never had before and what we'll be able to do is to take this rainfall, the results should be available almost instantaneously, the rainfall, and the rainfall rates and in a computer model, let it fall on a watershed and calculate how much of it's going to sink into the ground and how much of it is going to flow into reservoirs and how much of it is going to flow into a city producing a flash flood. We'll be able to do much better with NEXRAD derived rainfall estimates than we will with our current system of rain gauges.

In fact, I would imagine that the real economic payoff to NEXRAD might come from these water management activities. I could give you an example where you can actually save water if you use NEXRAD information in a proper way. If you have a reservoir, you have to lower that reservoir during the rainy season so that if you do get heavy rain, the reservoir will fill up without spilling over and flooding towns downstream. If you had NEXRAD, you could keep the water level higher, and as the rainfall fell upstream, you could let water out of the dam in the reservoir as water trickled in over a period of hours of days. Thus, you could keep the levels in the reservoirs higher, and actually save water.

As you went into the dry season, more water would be available for agriculture, use by people, et cetera, et cetera.

I'm also concerned about NEXRAD and the private sector in terms of as we delay the system, the possibility exists that we could lose foreign markets overseas. I've been told that companies in Sweden, Italy, Japan, and perhaps Germany have the capability of building NEXRAD-like systems and have obtained some information from the Norman community about Doppler weather radars.

I also think that a lot of the water management activity, flash flood forecasting using NEXRAD, would stimulate a whole new industry in the private sector. I can't see the National Weather Service or NOAA getting into this business for every small town, for every watershed, for every municipal reservoir. The NEXRAD system is designed so that one could go for a fee, get information out of that system as it's operating, and then build the model for Tulsa, let's say, at a cost that would be very effective because they would end up saving more money than the development of the model costs.

These are the kinds of things that I'm concerned with with regard to the National Weather Service budget for 1986 and I'd be happy to answer your questions.

[The prepared statement of Dr. Kimpel follows:]

# TESTIMONY

Prepared for the
Subcommitee on Natural Resources, Agriculture Research and Environment
Committee on Science and Technology
Hearing on NOAA FY'86 Budget
March 21, 1985

Prepared by
Dr. James F. Kimpel
Director, School of Meteorology
University of Oklahoma

Although my present position is primarily academic, I have had considerable experience in operational meteorology. I was an aviation weather forecaster for three years in the United States Air Force, and after coming to the University of Oklahoma, I spent several months at the National Weater Service Forecast Office at Oklahoma City. This experience gives me a very useful insight into the operational problem of the National Weather Service (NWS) and a better appreciation of the areas of meteorology which need further research.

To begin, the Congress is to be commended for their understanding of the National Oceanic and Atmospheric Administration

(NOAA) and the National Weather Service (NWS) in particular as evidenced by their massive restoration of proposed budget cuts during the last four years. No other federal service, except perhaps the Post Office or the IRS, is as widely known to the public. Unlike the IRS, the public appreciates the NWS. But, the National Weather Service is facing proposed cuts of $15.1 million (5.4%) in FY'86. An additional $44.5 million adjustment to NOAA's base which will partially affect NWS will undoubtedly have a major impact in further reducing NWS' ability to provide needed services.

As I look at the National Weather Service, I find a dedicated organization striving to provide quality service to the general public, aviation, agriculture, and industry through the provision of warnings and forecasts necessary for the protection of life and property. But I find an organization that is slowly being drained of the personnel and financial resources necessary to do a good job. Vacant positions are held open longer than is prudent. Staff levels are reduced so that necessary training cannot be accomplished. In the last four years 220 positions (from 5046) have been eliminated. The staffing level is falling because NWS has been required to absorb the cost of inflation and pay raises for 1985 on top of those for previous years.

The NOAA budget proposes a significant reduction in travel funds. Although the budget does not identify the distribution of these reductions to the individual NOAA organizations, I am concerned that any reduction passed to NWS will prevent the timely repair and maintenance of its equipment in the field and the vital work that NWS does with the Civil Defense authorities throughout the country.

The now annual budget cut - restoration process has seriously eroded NOAA/NWS managements' ability to conduct internal daily business, to plan wisely for the future, and to deal effectively with private and state organizations that form the partnership to deliver an effective and timely weather service to the people of this Nation. In the meantime, evidence is mounting that the U.S. National Weather Service is falling behind its European counterpart in the provision of accurate and timely weather forecasts and services (see New York Times Magazine, January 27, 1985). The consequences of a second-rate National Weather Service to the economic well-being and to the national defense of this country should need little debate. It is important that a consensus be reached in all areas of the federal government on the mission of the National Weather Service through the turn-of-the-century so that resources can be provided to support that mission.

The morale of National Weather Service technicians and forecasters in field offices scattered about the country is very low. Plans are cancelled, much needed technological improvement is delayed, training opportunities are minimal, and vacant positions remain unfilled.

It is important to the economic well-being of our nation that the National Weather Service be able to take advantage of new technologies. During 1983, 750 Americans died as a result of weather incidents and property losses amounted to $27 billion. Improvements in NWS forecasts and warnings are cost effective even if these losses can only be reduced a few percentage points. Improved forecasts and warnings depend on high-quality and timely observations of present weather conditions. In some cases, our weather observing systems rely on technologies that were state-of-the-art 30, 40, and even 50 years ago. Surface and upper-air observation systems are labor intensive, and the bulk of our weather radars represent obsolete technology. I am pleased to see that the FY'86 budget reflects the administration's commitment to profilers (a replacement for weather balloons), and the Automated Surface Observation System (ASOS), and the Advanced Weather Information Processing System (AWIPS). A similar commitment to an additional geosynchronous weather satellite (GOES NEXT) will again provide the satellite coverage we enjoyed in the 1970's and early 1980's. Proper positioning of GOES NEXT and the current geosynchronous satellite will allow the NWS to adequately monitor weather systems as they approach Alaska, Hawaii, and the continental United States and the Atlantic birthplace of tropical storms and hurricanes that affect the East Coast and Gulf states.

I am particularly concerned about the decay of the administration's commitment to the Next Generation Radar Program (NEXRAD). NEXRAD employs advanced Doppler technology and is designed to satisfy the needs of the operational atmospheric and hydrological communities and the public which depends on them for the next two to three decades. NOAA/NWS FY'86 budget planning appears to be the weak link in this interagency procurement with the Departement of Defense (DOD) and the Federal Aviation Administration (FAA). Compromises on implementation and requirements of this system, which is designed to replace our obsolete 30 year old weather radars, may result in short-term savings at the expense of increased costs over the long haul. The delay apparently is said to be to permit an evaluation of the proposed NEXRAD system with currently available "off-the-shelf" equipment. I know of no off-the-shelf equipment that comes close to meeting NEXRAD specifications. In particular, I am concerned about the following areas:

| | Issues | Example |
|---|---|---|
| (i) | The data quality necessary to accurately warn of tornadoes and other severe weather events; | Locations and velocities must be as accurate as possible; |
| (ii) | The ability to detect motion in clear air; | Detection of tornadoes and wind shears in rain-free regions; |
| (iii) | Reliability and ease of maintenance; | A minimum of down-time even in adverse conditions; |

| | | |
|---|---|---|
| (iv) | The availability of computer software to supply automated display systems geared to a knowledge of human factors engineering; | Radio/television announcers should be able to use the information effectively; |
| (v) | The ability to network all radars for hydrological and water management usage; | The use of multiple radars to obtain rainfall analyses over large areas; |
| (vi) | The availability of proposed training packages for NWS and private sector users; | Training packages are essential to make quick, effective use of the system; |
| (vii) | The capacity to upgrade the system as new technologies emerge; | Techniques are being developed to better detect hail. |

The NEXRAD system, as has been the case with its predecessor the WSR-57, can be expected to be in place for 20-30 years and therefore must be designed for future upgrades.

The NEXRAD system has been justified on the grounds that it is a much improved severe storm detection and warning device.

While true, I believe that the primary economic benefit will accrue from future upgrades that will allow it to accurately estimate rainfall rates. Thus, over time, accurate precipitation estimates will be available to meteorologists and hydrologists. Knowing rainfall and rainfall rates over a particular watershed will be extremely useful in the prediction of flash floods and for economically sound water management decisions. Like energy, water is a precious resource and rapidly becoming more so. Better management of flood pools in reservoirs and other water catchment systems could supply more water for agriculture, municipalities, industry, and recreational purposes.

I am also concerned about the impact that NEXRAD has on private industry. Of course the private sector will be heavily involved in NEXRAD development and manufacturing. The possibility exists that a delay in NEXRAD procurement could allow foreign competitors already developing similar systems more time to do so and thus reduce the impact of American manufacturers on the international market. Then to, there is a small but growing private sector meteorological industry. Many of these companies use NOAA/NWS observations, climatological records, and computer generated products to tailor forecasts and services to specific private users. Trucking, shipping, local governments, off-shore rig operations, power companies, and agriculture are becoming increasingly dependent on such value-added services. I envision spectacular growth in the area of private sector meteorology following the deployment of NEXRAD systems. These private companies will primarily be involved in developing software and display packages for a wide variety of special purpose, severe storm and flash flood warnings and for water management usages in specific locations. One of the primary users of this new industry will be the media, i.e., radio and television from which the general public gets much of its weather information.

For these reasons, it is important that the NEXRAD procurement not be delayed. If tests of off-the-shelf equipment are necessary, they should be made in a timely way under the strongest possible spotlight.

The National Weather Service serves each and every member of the general public in addition to private industry, state and local governments, and provides information and leadership to the international meteorological community. The time and energy spent by NWS on budget cuts proposed by the administration and later restored by Congress have a serious negative impact on employee morale, realistic long-range planning, and the exploitation of emerging technologies. Delays in implementing needed technological improvements, coupled with cutbacks in personnel, can only exacerbate the situation and fail to reduce the economic impact of weather related disasters. Opportunities for improved water management activities, much of it involving growth in the private sector, slip away.

Mr. McCurdy. Thank you, Dr. Kimpel. Mr. Miller, let's have your statement and then we'll do it together.

## STATEMENT OF DAVID E. MILLER, PRESIDENT, WSI CORP., BEDFORD, MA

Mr. Miller. Thank you very much, Mr. Chairman. With your permission, perhaps I could avoid reading my prepared statement and make a few comments and get into the questions.

Mr. McCurdy. That would be great. Your statement will be admitted into the record.

Mr. Miller. I am president of WSI Corp. of Bedford, MA. I represent the private weather industry that is made up of two segments: one, forecasting, and the other, real-time value added data or information.

It's the latter portion that we are skilled in and expert in supplying to industry. This relationship requires a great deal of information from the U.S. Government to be effective. The data we now receive is in raw form and is not very usable, in many cases, to the ultimate client and user. About 5 years ago, as often happens, a combination of technologies came about. The advent of the computer, computerization, communications, the desire on the part of the consumer to have information very quickly, and the ability to manage large data bases effectively came together simultaneously permitting the growth of a company like ours. We take this data and process and distribute it. This does require that information being supplied to us be in its raw form.

Our vision or concept is that we think the Government should be in the collection and management of raw material. Collecting the data in whatever form it best can and giving it to suppliers like us who, because we are very close to our clients, have a good feel for their needs. We are also able to move very quickly in adapting new technology for dissemination to economize and get that information to them quickly. We think that by so doing, a couple of things happen. One, the largest clientele possible receives the information. For instance, we supply satellite information to about 250 TV stations in this country and we believe that that reaches approximately 75 million people every day. I don't think the U.S. Government could do that same sort of thing in the same way we do in conjunction with TV stations like Bob Ryan's.

We also know that some portion of the cost for that activity, which would otherwise be borne by the U.S. Government, is passed on to the ultimate or intermediate consumer of that information. We also know, and I can tell you from my own experience, that it does create jobs. We are expanding and growing and we do pay taxes. So, we do gain on the other side.

We would like to suggest and urge that this is a very complimentary relationship with the Government. We are very pleased with the relationship that we have with the NWS and other agencies of the Government; we urge that continuance and we are very supportive of their activities.

We would like to tell you that you can be confident that there are companies like WSI who are willing and able to take information and provide it to the end consumer in some form. As budget pressures come on the Government, we could pick up the slack as long as there's a true demand for that product, and we can charge for it and be paid for it.

We do think that the Government resources should be concentrated on collection activities, on such things as the NEXRAD and other systems like that to collect data, and that information should be made available to us and to others so that we can disseminate it where our skills lie.

I would be pleased to answer any questions you may have.

[The prepared statement of Mr. Miller follows:]

TESTIMONY OF DAVID E MILLER BEFORE THE
COMMITTEE ON SCIENCE AND TECHNOLOGY,
U.S. HOUSE OF REPRESENTATIVES
MARCH 21, 1985.

I am David E. Miller, President of WSI Corporation of Bedford, MA. With me is Larry Denton, our Washington Representative. Thank you for the opportunity to appear before the Committee.

Let me begin by defining the roles of the public and private sectors with respect to the nation's weather information system. From our perspective, the public sector has three fundamental responsibilities; making the general public forecasts; issuing severe weather watches and warnings; and, in order to perform these missions, running a capable national observation network. The private sector, using the forecasts and data produced by the public sector, can and should provide all specialized forecasts, produce the "value-added" or tailored meteorological weather data to end users. This "value-added" processing is the result of expertise in meteorology, computer systems, data communications and a detailed understanding of special end-user requirements.

In the past 3-5 years, a new, dynamic and fast-growing weather industry has emerged in the United States. It is the business of disseminating rapidly changing, perishable weather information products in real-time, through a variety of communication channels. These information products are tailored to specific user requirements and are available in a wide variety of formats - raw code, tabular data, plain language interpretations, alphanumeric maps color graphics and imagery. WSI Corporation is one of the nation's leading firms in this business. We supply over 250 major TV stations and national TV networks (ABC, Channels 4, 5, 7 and 9 in the Washington area) with satellite pictures, radar images, meteorological data and forecasts for making their on-screen presentations. In the transportation field, companies such as AAA use our data products to inform their clients of on-route weather conditions in real-time, (i.e. where the severe weather conditions are on I-95 from Maine to Florida). In aviation, pilots and aviation operators phone directly to our data base and receive their route forecasts at minimal costs. In agribusiness, major food and grain companies receive information about weather conditions affecting crop conditions.

What this means is that, today, anyone with a push-button phone and a small personal computer can have access to all of the nation's weather data - data tailored to specific user needs and focused on specific geographic locations. This has been made possible by the recent advances in computing and communications technology which enable us to move and manipulate enormous amounts of data quickly and inexpensively. The "value-added" industry provides the end user with just the data, forecasts or warnings desired and formated or styled to meet his particular requirements. Thus, farmers, pilots, truck drivers, construction foremen or anyone in a weather sensitive business can now receive, at a very modest cost, real-time weather forecasts, watches and warnings and meteorological data for input to their day-to-day decisions. The point here is that in the dissemination end of our weather information system, a major advance has been made recently which will change the way all of us use weather information.

It is estimated that the nation's economic loss due to adverse weather is about $20 billion per year. So what should the public expect from our weather information system? In our opinion, the public should and will expect more accurate forecasts and better meteorological data. To create more accurate general forecasts and more timely watches and warnings, we need more and better observations. As mentioned, the national observation network is the responsibility of the public sector, specifically the National Weather Service (NWS). Therefore, our position, relative to the NWS budget, is that if we are to have an improved weather information system, and we think the time is here for real improvement, then we must have a strong, well-funded NWS - not one which is barely able to meet its responsibilities.

The NWS must build the next generation observation network if we are to realize this new potential. The network will include NEXRAD, ASOS, Wind Profiler and for data handling, AWIPS-90. NEXRAD, not just a new radar, but NEXRAD is needed to provide doppler radar images in a timely manner. ASOS and the Wind Profiler will give us continuous ground-based observations of the surface and upper-air, respectively. AWIPS-90 will permit the NWS to manage this enormous increase of data effectively. It is our view that significant improvement in the nation's weather information system will require the greatly improved observational and data management capabilities represented by these programs and we strongly support them.

Two Geostationary Satellites are necessary to give us complete coverage, e.g., for Atlantic and Pacific storms, and to ensure at least a minimun continuous coverage in the event one satellite fails. The demand for satellite coverage and the associated images increases steadily from our many users as well as the general public. Two Polar Orbiting Satellites are needed because the measurements provided by the satellites are necessary for making the general national forecasts and the associated watches and warnings.

Finally, our view of the future sees the public sector and the private sector "working together" much more closely in the national weather information system. Each sector has complementary strengths. The public sector has a unique role in issuing general forecasts and warnings and in managing the observation network which the private sector is effective in creating new applications and markets for meteorological data, and in providing specialized services tailored to end-user requirements. This cooperative public/private effort will take creative enlightened leadership from both communities. As an example, I would cite the NWS initiative, in conjunction with a number of private firms, in forming the "Family of Services" data delivery system. This is the system where private industry pays the government for weather data which, in turn, is further organized, processed and analyzed to focus on specific user information needs, and made available to end users at a reasonable cost. More of this "working together" will be required if we are to realize the potential of a significantly improved national weather informatiom system.

Thank you.

Mr. McCurdy. Thank you, Mr. Miller. First of all, since you spoke last, do you believe that the Weather Service should increase the fees that it charges the media for weather data since, in effect, the media are profitmaking and specialized users?

Mr. Miller. I would say no unless you're prepared to discriminate against media alone. I think if you're going to do that, in fairness, you would have to charge all profitmaking institutions; farmers, pilots, WSI. There are many users of weather information who are profitmakers who need that information that is publicaly available information. I think there are some fees associated with various informations right now. I think their level is adequate. I would urge not to increase them.

Mr. McCurdy. Dr. Kimpel mentioned that the Europeans have surpassed the United States in the quality of weather modeling. Do you agree with that statement?

Mr. Miller. I'm really not competent to answer that question. We use the synoptic information of the National Weather Service. I believe that most private firms in this country use the same data and I think that maybe through some of the technologies we have we can enhance some of that information, but I'm not competent beyond that to say.

Mr. McCurdy. You would agree that you—or you wouldn't be in the business if you didn't believe—that there's a whole new arena of potential use of weather information provided that we continue to progress in the type of collection and the type of data that we're collecting.

Mr. Miller. Absolutely.

Mr. McCurdy. Dr. Kimpel, sometimes Members of Congress are criticized because we have parochial interests and I'm sure that some of my colleagues might wonder if because of my interest in NEXRAD, that it's generated because I have a contractor in my district or someone that makes NEXRAD. Of course, that's not the case. I do have an interest because of the work that I've been able to see firsthand at the School of Meteorology, but also the National Severe Storms Laboratory. You have the opportunity—your statements as to NEXRAD are very important—have you had the opportunity in your work to compare the off-the-shelf technologies that are available versus what you foresee NEXRAD as being able to perform?

Dr. Kimpel. No; I haven't had the opportunity to personally do that. By being in central Oklahoma, we have the research prototype for NEXRAD at the National Severe Storms Laboratory. There were other commercial radars available in Oklahoma for the last few years. Frankly, they're so different and they're not necessarily what the off-the-shelf tests would be done with, that I would really hesitate to say anything about a comparison.

I will say that if we believe that the networking is important and if we're going to mix not only vendors but types of radars in the network, then I'm very concerned. For example, 10-centimeter radars verus 5-centimeter radars——

Mr. McCurdy. Would you amplify that? No one really got into that today. I am somewhat reluctant to open up a totally new field but I understand that the difference between the two systems is significant. Would you explain what the differences are?

Dr. **Kimpel**. Ten-centimeter radar simply means that the energy transmitted by the radar oscillates in waves that are essentially spaced 10 centimeters apart. Five-centimeter, obviously, 5 centimeters apart. Ten centimeter radars are larger, more powerful, and require a larger antenna but they have certain advantages. For example, a 10-centimeter radar is 16 times as effective as a 5-centimeter radar in penetrating precipitation. Remember, it's the precipitation that's the target that the radar sees. If you have heavy rain in the storm, you'd like to see all the way through that heavy rain. If you have a second storm behind that first storm, you'd have the opportunity to detect that second storm with a 10-centimeter radar. This might not be the case with a 5-centimeter radar.

For example, the 5-centimeter radar beam would be completely attenuated by the heavy rain. You'd never see that second storm. If we're interested in measuring rainfall and we're interested in detecting tornadoes and other types of severe weather in that second storm as well as the first, then you'd like to have the 10-centimeter system, the more expensive system.

Mr. **McCurdy**. Is that what you call fidelity?

Dr. **Kimpel**. That's OK.

Mr. **McCurdy**. Close enough. Mr. Valentine has joined us. I don't know if you had any questions or——

Mr. **Valentine**. Mr. Chairman, thank you. I do have one question that might have been answered previously.

I represent a part of North Carolina, the second district. Some of my constituents were affected by these killer tornadoes that came up from the southwestern part of the country last year. We had a hearing in my district, and it was my impression that one of the problems—I want to say now as I said then that I think that the Weather Service functioned quite well—there was some problem, real or imaginary with respect to the advance warning, the time that the people who were affected by these storms had to seek protection. I understand that in this time when we transmit TV programs by satellite all over the world, and when we use that advanced technology, that one of the methods that was used by the Weather Service to transmit the warning to eastern North Carolina involved a tower which was one of the structures that was destroyed by the storm. This meant that some people didn't get adequate warning. To what extent does the National Weather Service rely on the state-of-the-art instruments in transmitting warnings of approaching storms?

Dr. **Kimpel**. The Weather Service uses communication systems that are provided by others; for example, AT&T. There's very few towers that are designed to withstand the impact of a tornado. It was an unlucky event. What the Weather Service is in the process of doing now is that they are going to be subcontracting to private companies the transmission of the weather information that's available in Washington, DC. The idea is that this will go up to a satellite and then be broadcast all over the United States. For a fee, anyone can put up a dish and receive it. Those dishes won't withstand the impact of a tornado.

Mr. **McCurdy**. If the gentleman would yield, Dr. Hallgren is still here and perhaps he will be able to give you a very specific answer on that. Dr. Hallgren.

Dr. **Hallgren**. Never very specific. I can say that you are exactly right. What happened is that an AT&T tower was knocked out in the Carolinas. Therefore, what we call NOAA Weather Wire distribution system broke down. Let me emphasize what I think is so important. I have been saying all along that you must have a multidelivery system. That is, you have to have a number of ways in which you're getting the weather information out to the public. Sometimes, it's just simply because one person's in a car and another person's watching TV, and somebody else is doing something else.

It requires a multidelivery system. It also requires a multidelivery system because systems are vulnerable and you have to have various paths. In this particular case, NOAA Weather Radio never failed; we kept it going throughout the period. That one particular system had failed. We must continue to have a multidelivery system or we'll always have trouble if we ever got down to a single system.

Mr. **Valentine**. In this system, does the Weather Service make the best possible use of satellites? With more funding could you do a better job? I suppose the answer to that would be you could always use more money, which I'm not authorized to offer to you, you understand. With what you have——

Dr. **Hallgren**. I'm not authorized to request, sir. Let me just say that we are always trying to update the way in which we run the various systems. Keep in mind, we get information to radio stations just as effectively as we can; we get it to the television stations; we get it to the cable television stations; we get it over NOAA Weather Radio; we get it through the civil defense system; we're always trying to make those less vulnerable and as effective and efficient as we can and we are trying to improve it through more extensive use of satellite communications.

Mr. **McCurdy**. Any further questions? Gentleman, I would like to thank you for your expertise and your testimony today. It's been very helpful. I think the panel that testified clarified a lot of issues and I think that's going to be a very valuable record in the future.

I might ask you; do you have any major differences of opinion with what was stated regarding NEXRAD by any of the panelists in the previous testimony? Any differences of opinion or any points that you, from a science standpoint or from a commercial standpoint, would differ with?

Dr. **Kimpel**. No; I don't have any difference of opinion. I tried to supplement that somewhat in my statement.

Mr. **Miller**. Our position would be that we would support that collection activity. We need that Doppler radar to get better information to combine it with other information we have to make it a better system overall.

Mr. **McCurdy**. Very good. Thank you again for appearing and we will adjourn until next week.

[Whereupon, at 4:10 p.m., the subcommittee recessed to reconvene at the call of the Chair.]

# FISCAL YEAR 1986 NOAA AUTHORIZATION

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THURSDAY, MARCH 28, 1985

House of Representatives, Committee on Science and
Technology, Subcommittee on Natural Resources,
Agriculture Research, and Environment,
*Washington, DC.*

The subcommittee met, pursuant to notice, at 10:15 a.m., in room 2325, Rayburn House Office Building, Hon. James H. Scheuer (chairman of the subcommittee) presiding.

Present: Representatives Scheuer, McCurdy, Schneider, Smith, and Meyers.

Staff present: Dr. Robert Palmer, science consultant.

Mr. Scheuer. The subcommittee will come to order. OK, today the Subcommittee on Natural Resources, Agriculture Research and Environment will hold the third and last in a series of hearings on the fiscal 1986 budget of the National Oceanic and Atmospheric Administration—NOAA—and we'll be focusing on NOAA's budget request for two areas. The area of research and development, the so-called R&D and then the matter of the weather satellites that this Committee has been concerned with over the years.

Interestingly enough, in fiscal 1986, while sister agencies of NOAA, such as NASA, the National Science Foundation, and the EPA, all are slated to receive at least some increases in their R&D budgets, R&D in NOAA is, according to the administration, slated for about a 35-percent cut. Now, this is a cut of an enormous order of magnitude and we have received no satisfactory explanation for the administration—from the administration—for these massive projected cuts in NOAA's research capability, and we hope we will this morning. From what we've heard they seem to be based strictly on budgetary targets, regardless of the merits of the programs, the mission of the Agency or any conclusion or suggestion that research is of poor quality and shouldn't be continued. So, we hope we'll get some explanation and elucidation on these matters from the first witness today, Dr. John Knauss, dean of the School of Oceanography at the University of Rhode Island and Dr. Charles Hosler, dean of the College of Earth and Mineral Sciences at Penn State University. Our third witness, Mr. David Johnson, will testify on the fiscal year 1986 budget proposals for NOAA's Weather Satellite Program. And again, we'll again review the administration's proposal to eliminate one of two polar-orbiting weather satellites. The argument for this seems to be—the argument for retaining two satellites that this committee has held pretty strongly, hasn't changed, and that is the backup insurance provided by the second satellite. But, in addition to that insurance, that satellite service would not be interrupted for many months, there are several other reasons. First, the military depends on these satellites and I think that we have been told that if NOAA goes to a single polar-orbiting satellite the military will have to make other arrangements for their satellite weather reporting and other reporting services.

My staff aide tells me that they haven't admitted that publicly, so we can't say that that is their public position. In any event the satellite is not only helpful to the military and performed magnificantly in providing us with vital weather information during the Falklands war that was of invaluable assistance to our British partners, but they are critical to a number of other programs, including the so-called SARSAT Program, the satellite Search-and-Rescue Program, in which the Russians are giving us first-class cooperation. I guess there's always a justification and time to give the devil his due—the Russians are cooperating—and due to the Russian cooperation and the effectiveness of that program, that is based on a two polar-orbiting satellite system, we've saved over 340 lives of people lost—most of them lost at sea in fishing boats, pleasure craft, commercial aviation of one kind or another, people lost at sea, 340 of them, about half of them, about somewhere between 150 and 200 of them American lives. Now, I don't know how you put a value on a life, but its been an enormous assistance to our search-and-rescue efforts for people lost at sea and I don't thank the Russians for very much these days, but I do want to thank them for their cooperation in this program and this certainly—it seems to me this program alone is justification for the Twin-Orbiting, Polar-Orbiting Satellite Program.

The last one is the weather forecasting service that we provide about 120 nations, most of them in the developing world. We give them weather forecasts that are absolutely indispensible to them, in telling them what weather conditions they can expect and telling them what to plant, in giving them the information upon which they themselves, of course, decide what to plant, when to plant it, when to irrigate, when to fertilize, when to harvest, and they'd be lost without it. One already see famine conditions in Africa that threaten the lives and well-being of millions of people. One hesitates to think of how much worse this would be if their Governments were bereft and denied the benefits of the weather casting—weather forecasting services of our two polar-satellite system.

So, these are more or less the issues that we're going to address today and I'm sure we're going to build a useful record, having in mind the impending April 18, subcommittee markup of NOAA's fiscal 1986 budget.

I would now like to call upon my very distinguished and hard-working and vastly contributing member of the subcommittee, the ranking Republican member of the subcommittee, Congresswoman Claudine Schneider of Rhode Island, Claudine Scineider, who will make such remarks as she wishes to make and then when we have heard from Bob Smith and Jan Meyers and Dave McCurdy I'm going to ask my colleague, Congresswoman Schneider of Rhode Island, to introduce Dr. Knauss.

Ms. SCHNEIDER. Thank you. Well, Mr. Chairman, I will dispense with the illustratous attributes that you have used in conducting our various hearing and I know that you blush very easily, so I will not elaborate, but let me commend you on calling this hearing together today and in choosing the witnesses that you have so that we might get a better idea as to what the future of the NOAA budget request ought to be, particularly in the area of research and development. The R&D program request for 1986 is down approximately $73 million, to a level of $73 million, compared to last year's appropriation level of close to $132 million, a significant, significant reduction.

Some of the key activities that I hope the witnesses will touch on today would include their comments on the Great Lakes Environmental Research Laboratory and some of the Small-Scale Severe Weather System Program activities and the regional, observing and forecasting services. I'm anxious for the input from the witnesses to inform us as to what degree these reductions or these budget requests will seriously curtail the program activities. I think the NOAA budget request reflects the research recommendations from the panel on atmospheric sciences in the National Academy of Sciences, which recommended high leverage investments in several areas of atmospheric sciences and so I'll be anxious to hear what the witnesses have to say about that and particularly about some of the budgetary planning for Oceans Programs, the fact that it has been criticized as lacking interagency cooperation and as this committee has jurisdiction over the Environmental Protection Agency and NOAA and a few other agencies, we are always anxious to see what kind of cooperative arrangements are being utilized, so that we can maximize the research and the expenditure of taxpayer's dollars. So, I'm delighted that we will be hearing from these witnesses today and thank you very much, Mr. Chairman, for the opportunity to make a few comments.

Mr. **Scheuer**. Thank you, Congresswoman Schneider. Bob Smith of New Hampshire.

Mr. **Smith**. I have no opening comments, Mr. Chairman.

Mr. **Scheuer**. All right. Jan Meyers.

Ms. **Meyers**. No opening comments, Mr. Chairman.

Mr. **Scheuer**. Dave McCurdy.

Mr. **McCurdy**. Nothing, Mr. Chairman.

Mr. **Scheuer**. All right, then we'll go on to our next witness and I'll ask Congresswoman Schneider to take over from here.

Ms. **Schneider**. It gives me great pleasure to have the opportunity to introduce a constituent, but more important than that, a world recognized leader in the area of oceanography, Dr. John Knauss, who is the dean of the Graduate School of the University of Rhode Island. A school that has received recognition nationwide under his leadership, for the research that has been on-going and so Dr. Knauss has had a number of opportunities to participate in advice to the Federal Government in how we can best direct our tax dollars and our research and so Dr. Knauss, I welcome you today to our committee.

Mr. **McCurdy**. Will the gentlewoman yield.

Ms. **Schneider**. Sure.

Mr. **McCurdy**. How do you pronouce that in Rhode Island?

Ms. **Schneider**. Narragansett, my hometown. Named after an Indian tribe.

Dr. **Knauss**. Thank you, Mr. Chairman, Ms. Schneider.

Mr. **Scheuer**. Oh, yes; let's ask Dr. Hosler to come forward, too. Dr. Hosler, we're glad to have you. Dr. Hosler is dean of the College of Earth and Mineral Sciences at Penn State University. You've just heard Dr. Knauss' title. We'll ask both of you to speak to us for approximately 8 or 9 or 10 minutes and then I'm sure we'll have a chance to—we'll all have a chance to ask the witnesses some questions.

## STATEMENT OF DR. JOHN A. KNAUSS, DEAN, GRADUATE SCHOOL OF OCEANOGRAPHY, UNIVERSITY OF RHODE ISLAND

Dr. **Knauss**. Fine. Thank you, sir. I appreciate the opportunity to testify on the NOAA budget before the subcommittee on behalf of myself, as well as the marine division of the National Association of State Universities and Land-Grant Colleges. You have my testimony and I'll try to pick out just some of the highlights of that testimony as I go through it at present.

Let me start out by saying that the Marine Division, of which I am the present chairman, is a new division in Narragansett [NASULGC] and at present we have as members more than 70 major marine research and educational institutes in the United States. It represents, I believe, the core of our Nation's civilian oceanographic capacity. Let me start out by saying that it's very difficult for an outsider to fully comprehend the NOAA budget. It's a complex document and contains a number of major assumptions with respect to offsets, pay decreases, user fees, et cetera. Others who have analyzed this budget have indicated it results in a one-third reduction over this year's operating budget and I concur. One point I'm reasonably certain about is that anytime an operational budget is cut by a third you have a document that carries significant policy implications and I'd like to speak to that point for a moment, if I could.

Some years ago President Johnson appointed me to what came to be called the Stratton Commission. Our task was to make recommendations to the President and to Congress about the role of the Federal Government in ocean affairs. One of our recommendations was the establishment of NOAA. NOAA was to be the central civilian ocean agency, civilian ocean and atmospheric agency, but what I'm concerned about at this point is the ocean part of it. The central civilian ocean agency in the Federal Government. President Nixon accepted the bulk of our recommendations and NOAA was established in 1970 by Executive order. One of the policy implications in this budget and in most recent administration budgets is that NOAA is rapidly losing whatever claim it once had to that role. Perhaps ocean activities are too varied and complex today to think of a lead ocean agency, but I'm not yet convinced, nor are most of my ocean colleagues.

The ocean challenges today are greater than they were 17 years ago at the time of the Stratton Commission. The decision of this Government not to sign the 1982 Convention on the Law of the Sea increases, not decreases the ocean challenges this Nation now faces and will face. At the same time NOAA, which is presumably the lead civilian ocean agency, is being slowly, but surely reduced in its vision and in its opportunities.

The problems of NOAA would be easy to understand if one could believe it was a conscious administration decision to reduce this Nation's involvement in ocean activities, but this is clearly not the case. Let us consider only ocean research, which is the purview of this group. Ocean research continues to survive, if not exactly prosper, elsewhere in the Federal Government. The geological survey at the Department of the Interior is developing programs to study this Nation's new 200 mile exclusive economic zone. The Environmental Protection Agency has recently undergone a reorganization so that it can better focus on the problems of marine and estuarine pollution. NASA has shown renewed interest in developing an Ocean Satellite Program. The National Science Foundation's Ocean Research Program continues to grow and finally, of course, there has been a significant increase in Ocean Research Programs of the Navy as part of this Nation's defense buildup.

Nearly everywhere one looks in the Federal research budget one sees a steady commitment and sometimes a growing commitment to ocean research, except in NOAA. In NOAA we see Sea Grant Program reduced once more to zero, a program that is generally recognized as one of the more cost-effective research programs this Nation has. We see fishery research reduced by at least a third. We see a relatively small and new undersea research and mineral program phased out before they've had much opportunity to prove themselves. And once more the administration wants to close down the Great Lakes Environmental Research Laboratory. It wants to reduce NOAA's contributions to the Tropical Ocean and Global Atmospheric Experiment, called TOGA. If I read the budget correctly, it wishes to significantly reduce NOAA's Program of studying ocean and estuarine pollution. Although NASA is beginning to develop a major ocean research initiative I've been told there is no concurrent effort in NOAA to prepare for developing a research program to utilize this new information or to manage or distribute the data flowing from this program.

I'm acutely aware of the budget deficit this Nation faces, given the unwillingness of either Congress or the administration to offer an increase in taxes, but I confess to being perplexed as to why NOAA's Ocean Programs are reduced so drastically in the face of what appears to be a continuing interest in ocean research elsewhere in this administration.

Proposed reductions, such as we have had in this budget and which we have had in NOAA in the previous—in NOAA budgets in previous years can have a devastating effect on morale. It's difficult to sustain planning for long-term programs if your program is targeted for elimination or major reduction year after year. In time some people move on to other research groups where this kind of stress is less. Those who stay often become demoralized as they find that each January they're targeted for elimination, but each fall they are rescued by Congress. Perhaps more important, NOAA is ceasing to be looked upon as an attractive opportunity for the best and the brightest of our graduates in oceanography.

One consequence of this budget is to nearly terminate NOAA's partnership relationship with non-Federal entities. Relationships with universities, with State and with various fishery groups in industry are cut across the board. This is not a new phenomenon. Everytime the NOAA budget has been threatened in recent years these same programs have been the first ones proposed for sacrifice. In my university we refer to this as the "marching band" strategy, offering up as reduction to our legislature those programs we know somehow will be saved. More seriously, however, is the apparent mindset that's being reflected by those proposed reductions. It's a mindset of an inward looking organization and what is needed is a cooperative out looking operation networking across NOAA, other agencies and the national talent pool.

Let me illustrate this point briefly with respect to NOAA and the universities. American science is pluralistic, with contributions from universities, nonprofit organizations, industry, and Government laboratories. All are necessary for a healthy science base, and each has unique responsibilities. For the most part, however, the universities have become the main repository of scientific talent in this society. That is particularly true in oceanography. The most successful Federal scientific agencies have routinely provided substantial support for nongovernmental sciences. The point is not that universities ipso facto deserve support from the Government. It's rather that they are a major source of scientific talent for our national well being and they also have students and it is graduate students through their dissertation research who are the major wellspring of scientific advance in this country.

NOAA has been slow to avail itself of this talent pool. The establishment in recent years of joint NOAA/university centers in atmospheric, climate and satellite research has been an important step forward in this respect and with mutual benefit. However, Sea Grant remains the major NOAA/university interaction and Sea Grant has never been clearly embraced by the Agency. In the university R&D, including Sea Grant, seems to have been less than 20 percent of the NOAA budget, total NOAA R&D budget. I mean absolutely no reflection on NOAA's laboratories, the point is not university versus in-house, it's rather that in the long run NOAA must more fully avail itself of the academic talent pools to augment its in-house resources if it is to more fully carry out its service, the scientific and research missions. In the short run the agency is trying to go the other way and that concerns me.

Mr. Chairman, let me end on a more positive note. There are some important new initiatives in the ocean part of the NOAA Program. The decision to begin investing in new automated tide gauges is a good one, also I believe, is the new Fisheries Oceanographic Coordinated Investigation, called FOCI, which is an attempt to understand the interaction of biological and environmental factors which affect the year-to-year variation in fishery stock. Although I have some concern about the depth of the proposed reduction in ship support, I share the concern of many of my colleagues that the NOAA fleet is not as cost-effective as it could be.

However, in the final analysis one must be concerned about the policy implications emanating from a budget cut by approximately one-third in what was once thought of as the premier civilian ocean agency in Government. This is a reduction that comes at a time when other ocean research programs in the Federal Govern-

ment are at least holding their own in what is very widely recognized as a very difficult budget year for all nondefense programs.
Thank you, Mr. Chairman.

[The prepared statement of Dr. Knauss follows:]

Statement By

John A. Knauss
Vice President for Marine Programs
University of Rhode Island

Before the

Subcommittee on Natural Resources, Agriculture Research
and Environment
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Committee on Science and Technology
U.S. House of Representatives

on Behalf of the

Marine Division
National Association of State Universities and
Land-Grant Colleges

March 28, 1985

Thank you and good morning. I am John Knauss, Vice President for Marine Programs of the University of Rhode Island. I appreciate the opportunity to testify on the National Oceanic and Atmospheric Administration (NOAA) budget before this Subcommittee on behalf of the Marine Division of the National Association of State Universities and Land-Grant Colleges (NASULGC).

The Marine Division of NASULGC is composed of over 70 major marine research and education institutions in the United States which are committed to the conservation, development and understanding of the ocean and coastal environments. It represents the core of our nation's civilian oceanography capacity, with its institutions accounting for over 90% of the university marine research. Most members of the Marine Division are also members of NASULGC, which is composed of 144 colleges and universities with a total enrollment of approximately 2.8 million students. NASULGC institutions collectively represent this country's greatest contribution to higher education, the public research, education and public service university.

It is very difficult for an outsider to fully comprehend the NOAA budget. It is a complex document and contains a number of major assumptions with respect to offsets, pay decreases and user fees. It contains some fiscal year switches in which proposed FY 85 rescissions have been built into the FY 86 "base." I have been working from a document entitled, "FY 1986 Budget Summary, National Oceanic and Atmospheric Administration, U.S. Department of Commerce." The appropriation request for Operations, Research and Facilities (ORF) is $826 million, down $287 million from the FY 85 appropriation. In addition, the FY 86 program level assumes that $112 million in FY 85 proposed rescissions will be approved, and that other changes including a reduction of professionals and managers, and a five percent pay cut will save a further $30 million. The budget further assumes over 90 specific program cuts totaling $183 million. Against this, program increases of $94 million are proposed. Most of these increases are for satellite expenditures that are apparently logical commitments from previous decisions. Combining the cuts and offsets leads to a $395 million differential between the requested appropriation and the current base. Others who have analyzed the NOAA budget indicated that the budget proposal results in a one-third cut. I concur.

Any time an operational budget is cut by a third, you have a document that carries significant policy implications.

With the support of Congress and on the advice of the Stratton Commisison, on which I was priviledged to serve as a member, President Nixon established NOAA in 1970 as the premier civilian ocean agency in the federal government. One of the policy implications in this budget, and in most recent Administration budgets, is that NOAA is rapidly losing whatever claim it once had to that role. Perhaps ocean activities are too varied and complex today to think of a lead ocean agency, but I am not yet convinced of that position, nor are most of my ocean colleagues. The ocean challenges today are greater than they were 17 years ago at the time of the Stratton Commission. The decision of this government not to sign the 1982 Convention on the Law of the Sea increases, not decreases, the ocean challenges this nation now faces and will face. At the same time NOAA, which is presumably the lead civilian ocean agency, is being slowly but surely reduced in vision and in opportunity. As near as I can judge the consequences of these cuts is to leave NOAA as primarily a charting, atmospheric service and fisheries regulation agency. It severely reduces NOAA's role as a marine fisheries resource agency. It severely reduces NOAA's role as an ocean and coastal agency. It substantially reduces NOAA's position as a research agency. It also substantially reduces NOAA's partnership activities with non-federal institutions and groups.

The problems of NOAA would be easier to understand if one could believe it were a conscious Administration decision to reduce this nation's involvement in ocean activities, but this is clearly not the case. Let us consider only ocean research, which is the purview of this Subcommittee. Ocean research continues to survive, if not exactly prosper, elsewhere in the federal government. The Geological Survey of the Department of Interior is developing programs to study this nation's new 200 nautical mile Exclusive Economic Zone. The Environmental Protection Agency has recently undergone a reorganization so that it can better focus on the problems of marine and estuarine pollution. NASA has shown renewed interest in developing an ocean satellite program. The National Science Foundation's ocean research program continues to grow. Not the least of that growth has been the commitment to a new ten year Ocean Drilling Program. Our new drilling ship, the 471 foot JOIDES RESOLUTION has just completed her first leg and we are hopeful that the number of international members of this program will soon expand beyond France, Germany, Canada, and Japan who are already committed. And finally, of course, there has been a significant increase in the ocean research program of the Navy as part of this nation's defense buildup.

Nearly everywhere one looks in the federal research budget one sees a steady commitment, and sometimes a growing commitment, to ocean research except in NOAA. In NOAA we see a Sea Grant program reduced once more to zero, a program that is generally recognized as one of the more cost effective research programs this nation has. We see fisheries research reduced by at least a third. We see the relatively small, and new, undersea research and marine mineral programs phased out before they have had much opportunity to prove themselves. One more time the administration wants to close down the Great Lakes Environmental Research Laboratory. It wants to reduce NOAA's contribution to the Tropical Oceans and Global Atmospheric Experiment (TOGA). If I read the budget correctly, it wishes to significantly reduce

NOAA's program in studying ocean and estuarine pollution. Although NASA is beginning to develop a major ocean research initiative I have been told there is no concurrent effort in NOAA to prepare for developing a research program to utilize this new information or to manage and distribute the data flowing from this program.

I am acutely aware of the budget deficit this nation faces given the unwillingness of either Congress or the Administration to opt for an increase in taxes, but I confess to being perplexed as to why NOAA's ocean programs are reduced so drastically in the face of what appears to be a continuing interest in ocean research elsewhere in the Administration.

Proposed reductions such as we have in this budget, and which we have had in NOAA budgets in previous years, can have a devastating effect on morale. It is difficult to sustain planning for long-term programs if your program is targeted for elimination or major reduction year after year. In time, some people move on to other research groups where this kind of stress is less; those who stay often become demoralized, as they find that each January they are targeted for elimination, but each Fall they are rescued by Congress. Perhaps more important NOAA is ceasing to be looked upon as an attractive opportunity for the best and the brightest of our graduates in oceanography.

I am concerned about the continued viability of any agency that suffers a budget reduction of one-third. I am also concerned about how decisions are reached about program reduction or elimination. Does the elimination of the undersea research program mean that some interagency group, such as the Committee on Atmosphere and Oceans, has agreed that the present level of activity by NSF and the Navy is satisfactory where such programs continue to be supported? Similarly, before the reduction of the TOGA budget was there any discussion amongst the agencies concerned with planning as to whether this reduction would have a multiplier effect on the long-planned international program? Or is there no interagency agreement at all, and what we see is simply the result of budget proposals taking different pathways through the Administration to OMB and being subject to different budget examiners? Based on my experience while serving until very recently as chairman of the National Advisory Committee on Oceans and Atmosphere (NACOA), I am inclined to believe it is the latter.

One consequence of this budget is to nearly terminate NOAA's partnership relations with non-federal entities. Relations with universities, with states and with various fishery groups and industry are cut across the board. This is not a new phenomenon. Every time the NOAA budget has been threatened in recent years, these same programs have been the first ones proposed for sacrifice. In my university we refer to it as the "marching band" strategy, offering up as reductions to our legislature, those programs we know will somehow be saved. More serious, however, is the apparent mindset that is being reflected by these proposed reductions. It is the mindset of an inward-looking organization, when what is needed is a cooperative, outward-looking operation, networking across NOAA, other agencies and the national talent pool.

Let me illustrate the situation briefly with respect to NOAA and the universities. American science is pluralistic, with contributions from universities, non-profit organizations, industry, and government laboratories. All are necessary for a healthy science base, and each has unique responsibilities. For the most part, however, the universities have become the main repository of scientific talent in this society. That is particularly true in oceanography. The most successful federal scientific agencies--the National Institutes of Health, NASA and the Department of Agriculture, for example--have relied heavily on the universities for their science base, using a variety of arrangements. The Departments of Defense and of Energy, despite their heavy classified developmental needs for in-house activities, have routinely provided substantial support to non-governmental scientists. The point is not that universities ipso facto deserve support from the government. It is rather that they are a major source of scientific talent for our national well-being. They also have students, and it is graduate students through their dissertation research who are the major wellspring of scientific advance in this country.

NOAA has been slow to avail itself of this talent pool. The establishment in recent years of the joint NOAA/university centers in atmospheric, climate and satellite research has been an important step forward in this respect, with mutual benefit. However, Sea Grant remains the major NOAA/university interaction, and Sea Grant has never been clearly embraced by the agency. Until quite recently, at least, Sea Grant accounted for approximately 70% of all of NOAA's university involvements of all types, and approximately 60% of NOAA's university research effort. University R&D seems to have been less than 20% of the NOAA total. I mean absolutely no reflection on the NOAA laboratories. The point is not university versus in-house. It is rather that in the long run NOAA must more fully avail itself of the academic talent pool to augment its in-house resources if it is to most fully carry out its service, scientific and resource missions. In the short run, the agency is trying to go the other way, and attempting to eliminate its main source of interaction with the university community. NOAA needs to build on its Sea Grant capabilities, using them to enhance its university base and its total research effort.

Let me end on a more positive note. There are some important new initiatives in the ocean part of the NOAA program. The decisions to begin investing in new automated tide guages is a good one as is the new Fisheries Oceanographic Coordinated Investigation (FOCI), an attempt to understand the interaction of biological and environmental factors which affect the year-to-year variation in fisheries stocks, and although I may have some concern about the depth of the proposed reduction in ship support, I share the concern of many of my colleagues that the NOAA research fleet is not as cost effective as it could be.

However, in the final analysis one must be concerned about the policy implications emanating from a budget cut of approximately one-third in what was once thought of as the premier civilian ocean agency in the government, a reduction coming at a time when other ocean research programs in the federal government are at least holding their own in what is widely recognized as a very difficult budget year for all non-defense programs.

Mr. SCHEUER. Thank you, Dr. Knauss.

Dr. Hosler, we'd like to ask you to take 8, 9, or 10 minutes and testify. We'd prefer very much that you not read your testimony, but that you just talk to us informally, hitting the highlights of your testimony and then when you finish we'll go to some questions. Please proceed.

## STATEMENT OF DR. CHARLES L. HOSLER, DEAN, COLLEGE OF EARTH AND MINERAL SCIENCES, THE PENNSYLVANIA STATE UNIVERSITY, UNIVERSITY PARK, PA

Dr. HOSLER. It will be a pleasure sir. I don't think there's ever been a more exciting time in either the atmospheric or ocean sciences from the standpoint of the scientist. For the first time we have tools available to really see both of these environments. It's been a frustrating effort for 100 years as people have tried to study both of these media, and now with the advent, I guess the first major tool was the satellite, which enabled us to get a global view of both of these media, and now with the availability of modern electronics, which gives us the ability to gather and process huge amounts of data from these observing platforms. The ability to model some of the oceanic and atmospheric phenomena equations to the governing behavior of these phenomena were written 50, 70 years ago, but only recently did we begin to have the capacity and the computing power and the data handling power to really put these equations to work and do what we call modeling of the atmosphere using mathematical, numerical models to predict its future behavior. And so as a past-maturity meteorologist who struggled with the posity of data, I can remember as a Navy meteorologist, an Airologist in World War II, trying to forecast for the whole Pacific Ocean with three data points and trying to guess what the weather was in between. We now have the capability to see, really see what the weather, what the atmosphere is doing over the entire globe. Yet, we find that in this budget that enthusiasm is not reflected. I must say what is left in the budget is well thought out and they do move forward on all of these sophisticated systems that are now available, but the degree to which the—the pace is certainly not what the American people, in my opinion deserve, either in the way of discovering new knowledge about the atmosphere and the oceans or in providing practical day-to-day information to guide them in their everyday activities. One can always think of the obvious things like the operation of aircraft and agriculture, as you mentioned, where weather prediction has a great bearing, but I sometimes think we fail to recognize the millions of individual household type decisions that are made in this country and in other countries every day, which bear on the productivity, efficiency, and in some cases even health and safety that add really billions to our economy through the availability of good weather information. I think you only have to go back and realize that—whether it was Tom Jefferson or Benjamin Franklin—they were all vitally interested in this, and knew the bearing that this played in utilizing the resources of this country and that operating efficiently was to have some ability to make weather predictions for the day-to-day operations of people in whatever their pursuits might be.

I think that also we're on the verge of some major improvements in atmospheric predictability. One of the problems—we have great improvements that we've made in the last deade or two, but I don't think that people appreciate the confidence the public has in the forecast, the perceptions of accuracy are almost as important as the forecast. We're at the point now where we can make some major advances in forecast accuracy that will be very visible and very perceptible to people, which will then cause them to react more positively to weather forecast and warnings. Many times now, in the case of severe weather, we do a lot of crying wolf. We can only very roughly forecast where tornadoes, for example, will occur, or severe thunderstorms. With the precision that is now available to do this we can limit those false alarms, and people then when they hear the alarms will be more apt to react to them and seek cover or move into an unaffected area and so there—in my testimony I point out there are a number of systems, the NEXRAD system has been slowed down in this budget. It's still—the prototypes are going to be acquired and this new generation of radar—the radars we have now are 1950's technology. They are not Doppler radars. The Doppler radars enable us to not only measure the winds in the boundary layer and anticipate the formation of these severe convective storms that cause thunderstorms and heavy snow bands and tornados and hailstorms, you'll be able to anticipate the formation of some of those. I think I can assure you personally that if you put that—deploy those NEXRAD radars—there will not be a major tornado occur in these United States without some warning, and an additional 20 or 30 minutes warning on a phenomena such as that can be extremely crucial, especially if people grow to rely on those warnings because of the improved accuracy.

There's another development and that is the vertically pointing Doppler radar to get wind profiles in the atmosphere. I think you realize that now we send up balloons twice a day at a very limited number of points in the United States and it is now possible, and we have one of these operating at Penn State, the prototypes were built in a NOAA laboratory in Boulder, CO over the period of a decade of development, they've developed this technique to the point you can get continuous measurements of the wind speed and direction from 1,000 feet up to 15 kilometers, 40,000 or 50,000 feet above the surface of the Earth. The importance of this can't be overestimated in putting those data into the equations, into the computers to get the weather prediction, because our sampling now is very poor, both in time and in space, and as I indicated in the written testimony, it's the difference between having the doctor come in and check your temperature once a day or being in intensive care. If we really observe, continuously, what's going on in the atmosphere we can then get the inflection points. We can see where things start to change, which may be in between the regular observation points. So, we feel that it's very important as a meteorological community feels, to move rapidly into these new technologies and to deploy them, because every day you delay there are going to be unwarned storms and there are going to be bad decisions made or no good decision made at all simply because people feel they can't rely, particularly on these very short range weather predictions.

A few years ago you appropriated $10 million to put a new computer in the National Meteorological Center, a new Sovern computer, but we're only now, in this very week and in this very month, beginning to see the result of that with a considerable increase in the accuracy of the medium-range forecasts. These forecasts have now been extended out another day or day and a half from what they were just a short time ago. Now, you can't point in dollars and cents to individual decisions resulting from that improved accuracy and their impact on the economy, but I can assure you that it will be hundreds of millions of dollars contributed to the economy just on the basis of that $10 million investment. I feel the same is true of these relatively modest investments that will be required whether it's for another polar orbiting satellite, whether it's for the NEXRAD radar, or whether it's for the wind profilers or for the entire system that we're talking about. When you're talking about gathering data at the rates these instruments do, you need to talk in terms of an integrated system that can process the data and put it into useful form. So to cut out any part of that system or to delay any part of it really gets you less utility on the part of the rest of the system that you may have installed. So, again, you may sense a sense of frustration on my part that we're just ready to really move in this area, to get better data, better predictions, better understanding of the atmosphere. Again I must point out the tie between operations and research here. The basic research data that meteorologists use are the same data that people use in day-to-day weather prediction and operations. It is those historical data and data sets upon which we base our research, so that both the research and the operations will be deleteriously affected to the extent you delay deploying these new systems.

And so while I, like everyone else, recognize the stringencies under which you operate, I wonder if it isn't poor investment strategy to make such drastic cuts in the research and in the deployment, and the planned deployment of these new sets of instruments, whereas here we're talking about $100 million or so dollar-type investment and the billions of dollars that it can contribute to the economy. It's been estimated in the case of these wind profilers that hundreds of millions per year would be saved just in aviation fuel because of the more accurate winds that the commercial aviation and general aviation community would have upon which to base their routing and their altitude and their operations.

So, I think I'll stop there and I'll be pleased to entertain whatever questions you might have.

[The prepared statement of Dr. Hosler follows:]

# TESTIMONY BEFORE COMMITTEE ON SCIENCE AND TECHNOLOGY
# U.S. HOUSE OF REPRESENTATIVES

CHARLES L. HOSLER
March 28, 1985

I am Charles L. Hosler, Dean, College of Earth and Mineral Sciences, The Pennsylvania State University, University Park, Pa.

Over the past decade I have had the opportunity to review NOAA activities and the National Weather Service a number of times as a member of various panels of the National Academy, while serving on the National Advisory Committee on Oceans and Atmosphere (NACOA), and as a consultant to NOAA. I view the 1986 NOAA budget as structured as very constrained, but it does provide some important steps forward in preparing the National Weather Service for the future. The formal beginning of the Advanced Weather Information and Prediction Systems (AWIPS) program is to be applauded as is the commitment to a new operational geostationary satellite program (GOES NEXT). The beginning of development, testing and deployment of a doppler radar wind profiler is commendable. The NEXRAD program must continue as has been affirmed by several recent reviews. These high quality data systems, NEXRAD and GOES NEXT, can be exploited by the weather forecasters using AWIPS and similar facilities together with the products of the research and development community to promote aviation and transportation safety, and better warnings of severe storms of several types.

When I review the NOAA budget proposals, however, I am disappointed that NOAA did not go far enough. It is time to ask NOAA to take the leadership role in the National STORM Program, to forge together these emerging technologies and systems with the research necessary to fully understand the behavior of the small scale storm systems, such as thunderstorm systems, that move across the country. Insight may also be gained on hurricane prediction. A sustained STORM Program will provide NOAA the means of fully exploiting these new systems. The National Weather Service's ability to provide better warnings and forecasts to this country hinges upon developing of this complex system.

The budget put forth by the administration very wisely put emphasis on the development of doppler wind profilers. These vertically pointing doppler radars will ultimately replace most other wind observations from balloons. Whereas today we get two observations per day, these instruments give continuous observations. This can be likened to continuous monitoring of vital signs in a hospital intensive care unit as compared to checking the patient twice each day. Things happen between observations which can make a big difference in the outcome in both the case of a weather prediction and the patient's prognosis. This program must and should go on. In my opinion, the weather prediction for six to sixty hours will improve dramatically as a result of the information derived from a wind profiler network. The mathematical modeling of the atmospheric processes hinges upon accurate and timely winds through the depth of the troposphere.

From the national point of view profiler wind observations will pay for themselves. It has been estimated that the accurate and up-to-the-minute wind observations will save hundreds of millions per year in fuel for domestic aviation alone. Military aviation can also benefit. This observation system will require continued research on how the new information can best be integrated into our forecast system. The NOAA budget as presented does not recognize this need. The indicated decrease of $2.5 million for research on mesoscale convection systems will also slow the development of an important capability.

The budget presented has a drastic cut in the funds required to deploy the NEXRAD system. However, the budget does include building prototypes for comparisons and testing. The high resolution horizontal scanning doppler radar contemplated for NEXRAD will replace radars with 1950s technology with radars with much greater capabilities for detecting small violent storms and monitoring their development and movement. In deciding whether to slow down the deployment of NEXRAD, you are asked to decide whether an extra twenty or thirty minutes warning of a developing or approaching tornado or a flash flood is worth the investment of a few million dollars to a town in your district. You may be deciding whether there will be any warning at all. I believe it can be stated that with national coverage by NEXRAD there should not be a major tornado occurrence without some warning. In addition, this radar will anticipate and see severe snow bands, hail, heavy rain leading to flash floods, etc., and will greatly improve all very short range prediction (minutes to several hours). We should at least begin deployment in the tornado belts and along the coastlines.

The NOAA labs and the National Weather Service will need research money to show how to get the most out of the NEXRAD. There has been talk of replacing this system with off-the-shelf radars. I would caution that the attendant data processing software and displays are very important to the utility of the system and the Congress needs assurance that the specifications for NEXRAD are met by any substitution. The power and radiating characteristics and the ability to measure motions in clear air are all critical to the task to be performed.

I am concerned that only one polar orbiting satellite is provided for. This means that there is no back-up in case of failure with the resulting loss of global coverage. The GOES satellite does not cover the polar regions.

In sum, the budget contains elements of useful approaches, but it fails to follow its own logic. If more were expended in the right places the nation would profit and less would need to be expended later.

A few years ago you authorized the new Cyber computer for the National Meteorological Center. As of today, indications are that useful forecasts have been extended by 1.5 days as a result of being able to put better physics into the model and still have it run in reasonable time. These forecasts will now be used for better planning and risk avoidance and contribute many millions each year to our economic prosperity. In addition to direct use of these products by the public, hundreds of private forecasters and companies are engaged in refining and disseminating these products to clients who use them in planning and operations. For an investment of the order of ten million by the government, hundreds of millions in taxable economic gain have resulted. The Congress and NOAA are to be congratulated on this action. We have even greater opportunities for tangible improvements waiting for us to act.

The remote sensing, electronic, communications and computing revolution, which engulfs us all at this moment in history, has placed us in a position to improve greatly the quality of the information meteorologists and climatologists use and to further improve the accuracy of weather prediction. Improved accuracy in itself will contribute to the common good but the improvements in short-range prediction now foreseen will also raise public perceptions of accuracy to a point where people will be more willing to act on the prediction with accompanying savings in life and property. Thus, while we must all work to cut government expenditures, it seems sad that by elimination of tens of millions per year for a few years, billions in savings will be foregone and lives will be unnecessarily lost. In your wisdom you will be making many decisions of this kind during this congress. I would like to urge that as you make these decisions, you consider the value of accurate and timely weather predictions in making the millions of individual decisions which contribute to the quality of life and the productivity of the American economy. This is truly a government activity. The individual contributes to government for just this sort of thing. Government can be very cost-effective in providing the data and information upon which individuals and businesses act and from which corporate bodies can derive salable information products.

Mr. **Scheuer**. Well, very good. I want to commend you both for your very interesting and informative testimony.

Dr. Hosler, you indicate that maintenance and improvement of the climate research and weather forecasting programs and in the technology that produces sophisticated long-term and short-term weather programming, would enormously pay great dividends to our country. Can you tell us the kind of benefits, both economic and other benefits that much more accurate and more timely weather forecasts would play both in—and what kind of benefits it would provide, both in our country and overseas in the 120 countries that are currently relying on our weather forecasts mostly for agricultural use?

Dr. **Hosler**. Yes. Every winter we go through this thing, you see on television these hundreds of cars and trucks in the ditch along the freeways of New York and Pennsylvania, Nebraska, and in Colorado. Wouldn't it be nice to think that we could slow down the traffic and divert the traffic or stop the traffic before that happened? Well, I think that's possible. The snowbursts and the heavy snow bands that produce it, in my opinion, could be much more accurately anticipated. Right now, we suffer from lack of precision because of the scale on which we have the observations. Again with these Doppler radars we'll be able to see winds in the boundary level next to the Earth, with the horizontally pointing Doppler radar, which will anticipate where those snow bands are going to be and see them form. So the highway patrol will be able to regulate traffic to avoid these disasters and sometimes loss of human life. And again, to stay on the snow for a moment, in an east coast northeastern city or in Chicago, it would allow for the crews to be able to anticipate hours ahead of time when one of these snow bands is going to hit and get ahead of the snowstorm, rather than having it come down faster than they thought and then have to stop all the traffic and get all the parked cars out before they can clean the highways. Again, even with an individual city like New York, you're talking about tens of millions of dollars in savings just in snow removal operations alone, let alone the loss of business due to the slowness or inefficiency of those snow removal operations.

Flash floods. Each year many people lose their lives in this country because of flash floods in mountainous or hilly terrain. You can't prevent a flash flood. No one can design a flood control system that we would want to pay for that could take into account a 12-inch rain in a matter of a few hours. But with these radars you'll be able to see the conditions leading up to the formation of that severe convective-type precipitation and be able to get actual quantitative ideas of how much of that precipitation is falling and is there, and again get, perhaps an hour, perhaps a half an hour earlier warning than one might have otherwise.

So, whether you're talkling about snow, whether you're talking about heavy rain, or of course the one that people always point to is the tornado—and they can occur almost anywhere in the country, of course we hear about it most in the Midwest, but they can occur anywhere on the east coast. We had one in Florida just last week that did severe damage. You can't remove the houses. You can't prevent the property damage in that case, but you can certainly get people conditioned to the point where they will seek shelter and be in a place of much greater safety than is now generally the case when a tornado occurs.

So I think there are many economic advantages—especially overseas, of course. Our observation system—we belong to a world meteorological organization, which is over 100 years old, which coordinates the exchange of this data and observations throughout the whole world, and as you've indicated, the Chinese, the people in Africa depend very much on the satellite data that we make available to them. Help them in receiving it and in interpreting it, and a witness who will appear here later can speak much better than I can in that area. But, the fact is that we are contributing to the global economy and the global health and safety through our major contribution to this global observing system.

Now, there are many oceanographic systems to measure scattering from waves on the ocean by an airborne radar, which can give us not only winds in the very lower layers, but of course give us some idea of the currents that result from those winds and other forces. These affect the fisheries and the ability to find where fish will be and of course a lot of the world's people are eating protein coming from the ocean, anything we can do to more efficiently and effectively exploit that resource is to the benefit of the world.

I think, as you well know, there are so many areas where this country contributes disproportionately to the well being of the rest of the world. I think, certainly in the meteorological and oceanographic community, there is general recognition and good will because of the input we have to their data pool that they have available for them to do their—operate their internal economies, whether it's flood control or irrigation or agriculture.

I was impressed several years ago in the People's Republic of China. Whereas they have a very crude meteorological system in many ways, the fact that they have some 45,000 people they call meteorologists and in every little commune and every little county and every group there is someone who is issuing the warning. They go out and cover the grain that's drying, or they change the patterns of irrigation and waterflow in order to minimize the damages that the weather, the ravages of the weather, might have on their limited food supplies. I was in Algeria last March and again there they've become a food importing nation, like many of the Third World nations, and they don't have a good irrigation system. They don't coordinate as well as they could with the weather, with better weather prediction, and they don't coordinate the use of their few irrigation dams as well as they might. So aside from sending bundles of food to those places, one of the things we can send is scientific capability, scientific knowledge and the data that these systems collect, which would enable them to apply that science to minimize damage, to maximize productivity in their agriculture and the rest of their economy. That's a long answer.

Mr. SCHEUER. Well, it was a long answer. It was an excellent answer. Comprehensive answer. I really should pass on now, but I'm going to ask you one more question. Before I do I just want to add to what you said. Algeria has become a food importing nation. A generation ago every single country in sub-Saharan Africa was a food exporting country, now every single nation in sub-Saharan Africa is a food importing country and there are two reasons for that. One is that they don't grow enough food. The other reason is that they have a tremendous rate of population growth. They've got to get a handle on both. They have to increase their food production and decrease their people production and one of the ways they can increase their food production and therefore depend less on importing food with the precious dollars that they get from their cash crops, is to do a better job of using improved information of all kinds. You certainly hit the nail on the head.

The research planned for NOAA—I'm going to ask Dr. Hosler questions because I know that my colleague is going to overwhelm you with questions, Mr. Knauss, and I only have time for one more question anyway.

The research plan for NOAA—and you can answer this question too. I'm going to ask it of both of you—had a $10 million in there for study of nuclear winter. Now, we had hearings—we had a hearing in this committee on the subject of nuclear winter with a very distinguished and brillant representative from the Defense Department, Assistant Secretary of Defense, Richard Perle and Dr. Carl Sagan and others. The position of the Defense Department was that the—that those who expose the issue of the nuclear winter hadn't proved their case, by far not enough was known about it. They had only made the haziest parameters of their case and until far more research was done this was a nonstarter, this whole concept of nuclear winter. Now, the research plan calls for $10 million a year in nuclear research, yet the request from the Administration was for $5.5 million, almost a 50 percent cut in the research program to investigate and identify and clarify the phenomena known as nuclear winter. While at the same time they're sort of debunking the concept of it because we don't know enough. Does that strike you as an apparent anomaly? I don't want to put words in your mouth, if I'm being unfair please tell me.

Dr. **Hosler**. If I may comment on that, unfortunately this whole program has come down to more of a philosophical and political debate than a technological debate and the people fall on one side or the other depending on their political philosophy rather than what they really know scientifically, that's my opinion.

Mr. **Scheuer**. Well, it shouldn't be political and it shouldn't be philosophical, it should be scientific and in the fine research plan which NOAA has developed, interestingly enough even though they've developed this research plan NOAA has no ongoing role in the nuclear winter research whatsoever. First, comment on the almost 50 percent cut in the administration program for nuclear winter and then, what role, if any, do you see for NOAA in the meteorological and climatic research that would help us clarify the phenomena of whether there is or whether there isn't the phenomena that Carl Sagan and others describe by the term nuclear winter? And what additional funding do you think would be required if NOAA were to engage in a major nuclear winter research effort?

Dr. **Hosler**. Certainly NOAA should play a central role in any effort in this direction. This is basically a meteorological and cloud microphysical problem. The original——

Mr. **Scheuer**. What was that phrase? The last one.

Dr. **Hosler**. Well, cloud microphysical.

Mr. **Scheuer**. Cloud microphysical.

Dr. **Hosler**. Yes, what I mean to say there is—that one of the big questions up front in that is how rapidly in the initial hours following a nuclear holocaust, how rapidly will the smoke and dust that's raised be removed. Unfortunately we jump very rapidly to "boy, there's going to be a lot of smoke and dust," and there certainly is, to the global effects of that on the exchange of heat and radiation in and out of the atmosphere. There are a lot of very unanswered questions about the nature of that smoke and dust and how rapidly it will be removed. Most certainly there will be all sorts of severe weather, accompanying this major release of energy. If it happens in the summer there will be thunderstorms and heavy downpours, which, as was observed in Hiroshima, will bring down a lot of this material and may alleviate the severity of it. But no matter how that comes down after the research is done, there still will be important radiative effects of the large cloud of dust and smoke that will be produced.

Our models in atmospheric science that we use for weather prediction are very inadequate in the area of assessing the influence of clouds and dust on the heat balance of the earth. What is very fundamental is what this does to the atmospheric circulation and to the temperature distribution on the ground. So, most certainly I personally come down that we're pretty ignorant in this area, basically because we're pretty ignorant about many basic atmospheric processes, in addition to those processes that will relate to the fires and configurations that would result in a nuclear bombing attack. So that I think there are many problems we face in that particular question—in that particular question that are problems that are more general in the atmospheric sciences. So I guess that I'm not an unbiased witness in that I'd like to see the money go into that research to answer some of these fundamental atmospheric questions, which, by the way, would of course answer the questions associated with nuclear winter.

Some of the statements that were made, I think initially, were based on a very simplified type modeling of the atmosphere and as usual we went off perhaps on the deep end on one side, and then on the other side. I think we perhaps were ultra conservative in saying we didn't know anything. The truth, as usual, lies somewhere in between. The original program proposed by the Climate Program Office in NOAA was about a $25 million program and that got down to $10 and now down to $5. I think $10 million could be very profitably invested in investigating some of these fundamental questions that are asked about rates of removal of pollutants put into the atmosphere in that way, which would be generally applicable, perhaps to some other types of pollutants and to the circulation and temperature implications of the radiation effects of these particular pollutants in the middle atmosphere.

So, I guess I am somewhat disconcerted that NOAA backed off there and that this did not stay in the budget—I would like to comment on what Dr. Knauss said that, you know, NOAA should—is basically a scientifically-oriented agency, or should be, and is providing services based on the science. I'm afraid that because it's in a nonscientific executive department perhaps the scientific impact it can have on the community at large is not as appreciated as it might otherwise be. I'm one of those who——

Mr. **Scheuer**. You mean if it were standing on its own?

Dr. **Hosler**. If it were standing on its own I'm one of those who feel—and that goes back to a reorganization plan presented during the Nixon administration that would have put this—I believe the Department of Natural Resources, but I think either a stand-alone case or a case where it is an organization which is basically scientifically concerned would yield many benefits both to NOAA, the atmospheric sciences, the ocean sciences and to the country at large.

Mr. **Scheuer**. I understand what you're saying and I sympathize with what you're saying and we have—we are absolutely dumbstruck that the lead scientific agency in weather and climate phenomenon of all kinds should have been cut out of this research and half of it should be in the Department of Energy and half of it should be in the Defense Department, neither of which, despite the eminence of their scientific effort, are nearly as centrally located in this whole meteorological business as NOAA is. And it seems to me so obvious, so tranparently obvious that they should have been the lead agency in this, I wonder if either of you, and I would ask both of you if you have an explanation for why they were cut out of this matter. Is this some kind of scientific apartheid? They're being segregated and pushed out.

Dr. **Hosler**. I don't know, but perhaps people underestimate the complexity of the oceans and the atmosphere. It takes many years of involvement in it and frustration, to realize. Like all things in life once you really look into them, it's extremely complex. I'm afraid some of the superficial looks that have been taken of this by excellent scientists in other fields have been oversimplified and that it will take them years to get to the point where some of the NOAA scientists would be right to start with in really examining this problem.

Mr. **Scheuer**. Yes.

Dr. **Hosler**. Every now and then a fresh look at a question is good by someone on the outside——

Mr. **Scheuer**. Well, to get back to my question, why do you think they were fenced out, closed out?

Dr. **Hosler**. I defer to John Knauss, he's an old veteran of NOAA.

Dr. **Knauss**. I think it perhaps is because they are in the Department of Commerce. Now whether or not it is because of this particular administration and the Department of Commerce or whether it's because they're in the Department of Commerce period is a little less clear. I mean clearly NOAA has been in the Department of Commerce since 1970 and there were periods during that time when it did quite well. It has not done well recently. As you pointed out they do not have the lead in nuclear winter. They do not have the lead in the—another problem equally important, namely the carbon dioxide, the warming up, they play a very small role in that.

Mr. **Scheuer**. The greenhouse effect.

Dr. **Knauss**. The greenhouse effect. They play a very small role in acid rain research. There are a whole range of major environmental problems that this country is facing, marine pollution and things of this nature, NOAA is no longer the lead agency. I guess that was the whole point of my testimony, NOAA is no longer the lead agency 1n ocean and atmospheric research and it's very discouraging and disturbing.

Dr. HOSLER. And I might add that I sit on a science advisory board, or I did until recently, for EPA, which gets into many of the air-pollution-type, acid-rain-type problems and again they are not staffed or equipped to handle many of these problems, which should have been problems addressed by NOAA as the chief scientific agency in this area. It seems to be an across-the-board problem that things get sorted out in ways that are not logical. Now it may be logical from a political point of view, but it's certainly not logical for a converging on a scientific solution to a problem.

Dr. SCHEUER. Dr. George Keyworth, the President's science adviser, recently said that NOAA's R&D is characterized by "poor quality work" and "pork barrel programs," and those are quotes. Do you agree and is there a general perception that NOAA's R&D programs are either poor quality or unrelated to NOAA's mission? Now, we have a rollcall vote coming up. We're going to recess now for about 12 or 13 minutes and when we come back we'll let you answer—both of you answer that question and then I'll yield to my colleagues.

[Whereupon, a recess was taken.]

Mr. SCHEUER. All right. The subcommittee will come to order. When we left I had just posed a question. I hope it's been searing through your minds since then. What do you have to tell us, Dr. Hosler?

Dr. HOSLER. There is excellent research in NOAA. There is also some pedestrian research in NOAA. But I think the thing we're discussing this morning has some bearing on the quality of research. Because of the low morale in some of the laboratories and because of the buffeting they've taken on the budgeting and the uncertainly, I think as Dr. Knauss indicated earlier, maybe the best scientists in the world no longer aspire to be in some of those laboratories because of the way in which they've been looked upon by the people who run NOAA in commerce and because of the——

Mr. SCHEUER. The people who run NOAA in Congress, did you say?

Dr. HOSLER. No; in the Commerce Department.

Mr. SCHEUER. In Commerce?

Dr. HOSLER. No; I know better than that.

Mr. SCHEUER. My bipartisan hackles were going up.

Dr. HOSLER. That's right.

Mr. SCHEUER. On behalf of myself and all my colleagues.

Dr. HOSLER. No; I really think that the atmosphere in Commerce—most scientists don't aspire to work for the Department of Commerce, let's put it that way. I think that that may be detrimental. But, I think also this uncertainty in the buffeting, this off-again, on-again thing. Almost all science is a long-term proposition where you develop a team and you get things into perspective and then you start to really operate on the problem and unfortunately we've very often in Government invested very largely. In another—well, another hat I wear, I've seen this in the Fossil Fuel Research

Program in the Department of Energy where you suddenly throw $900 million a year at something and then you whack it down to $200 million a year. It is this kind of oscillation that is money very poorly spent because it comes on too fast and it goes off too fast. There's no way you can start solid scientific programs all of a sudden. It takes time to phase into it. I wish the budget process were such that we could take long-range looks and phase into and out of programs. But instead, it's either all or nothing it seems and I think it has had disastrous results on morale. It has disastrous results in terms of getting "the bang for the buck," in doing things in an efficient and sensible way.

Dr. **Knauss**. I think Dr. Hosler said it all. I agree there's very good research being done in NOAA. There's some pedestrian research. I'm concerned about the low morale in NOAA. I'm concerned about the fact that some of the best people that we are turning out of our universities no longer think that NOAA is a good place to go to work. So, indeed it could be a thought provoking prophesy.

Mr. **Scheuer**. Let me just ask you to zero in on that, hone in on that. Is that because of the poor quality work and pork barrel programs——

Dr. **Knauss**. No, sir.

Mr. **Scheuer** [continuing]. That Dr. George Keyworth has spoken about or is it because of the—is it the failing inadequate contentious leadership that NOAA is getting from the Commerce Department? I don't want to put words in your mouth.

Dr. **Knauss**. I understand and you will not.

Mr. **Scheuer**. Tell us what you think the cause is of the fact that our Nation's greatest scientists, especially the young promising scientists who are just beginning to show some flower and promise in their careers, don't seem to want to gravitate to NOAA?

Dr. **Knauss**. Well, young scientists are not necessarily the most politically astute people in the world, but they do know something and when they see programs, the administration zeroing programs and taking money out of programs and not giving the leadership of certain programs to NOAA they will look elsewhere to where they're going to start their careers, if they have an opportunity to. And the fact that programs are zeroed and then they go back up again, the fact that Charlie Hosler mentioned, the difficulty of long-term planning in NOAA because of this kind of a budgetary cycle. It's hard enough to do long-term planning in any Federal agency, but in NOAA, because of this up and down effect, it's much worse, so I think those are the primary reasons I would see as to why there's a difficulty. Not because there's low-quality research being done in NOAA. I don't believe that there is—well, there is very good research being done at NOAA. Everybody can point to some research—I can point to some research at my university that's not all that good, too. I mean there's always some areas where it's not top drawer.

Dr. **Hosler**. I guess I would address a leadership problem, I don't mean to cast dispersions on either present or past leadership or the men as individuals, but at one time—and I'm trying to think of the year. I guess it was in the Carter administration, that we changed from having a scientist leader in NOAA to having just plain administrative types, either from legal backgrounds or other backgrounds within the bureaucracy. While these people may have been excellent bureaucrats and excellent administrators in one sense, I don't think they possessed the scientific insight to inculcate the people under them with enthusiasm and with the idea that they understood what they were up to. At my age I begin to realize that leadership counts, whether it's in the national politics or in universities or any scientific establishment.

Mr. SCHEUER. How could there have been any iota of doubt in your mind up to now?

Dr. HOSLER. Well, there were times when I was younger that I wondered if I didn't know better than the people in charge.

Mr. SCHEUER. Bob Smith.

Mr. SMITH. Thank you, Mr. Chairman. I'm not a lawyer, if that means anything. I got elected. In your testimony, Dr. Knauss, is that——

Dr. KNAUSS. Knauss, yes; I do pronounce the K in it.

Mr. SMITH. Sometimes you don't pronounce it.

Dr. KNAUSS. Those are the ones that have given up trying. They're the weak-willed part of the Knauss family. They give up correcting people.

Mr. SMITH. I don't have that problem with my name, so. In your statement on page 2 you indicate that—excuse me, page 3, you indicate that you don't feel that it's a lack of commitment elsewhere in the administration with some of these cutbacks and I think the thing that concerns us, I'm really stunned by the magnitude of the reductions that you have—I shouldn't say you, I know you're not a member of the administration, but I'm stunned at the amount of the reductions that you're here highlighting here for us and reductions in the budget and NOAA and I guess from one member's point of view here, are these reductions, in fact, being picked up elsewhere? You indicate—you mention some of the other, EPA, Department of Interior, Commerce, et cetera, further on in your testimony. If they're not, and I think you infer that they are not, what specifically—give me some priorities in where we can restore these things and what are these things that we need to restore, specifically?

Dr. KNAUSS. Well, the first part of your answer, sir, is no, to the best part of my knowledge they're not being picked up. And there's deep concern in other parts of the Federal Government for such things. For example, you have a deep sea submersible program which is currently supported by Department of Transportation [Navy], the National Science Foundation and NOAA, it has been for years. Then NOAA turns out that they don't come forward with their part of the budget. It becomes very difficult to maintain that program. There's a ripple effect, if NOAA can't come forward with say its small part of the support of the Alvin operation, you have the TOGA Program, I'll refer to it again. It's a joint program with a series of agencies. If NOAA can't come forward with its part of the support you have a ripple effect throughout all of the Federal Government and program managers, I think it's no secret in this city, are very uneasy about entering into joint arrangements with NOAA at this time because they can't count on their NOAA program manager, at that level, being able to produce at budget time on these things. So, that's one type of concern.

As to where—what are the most important things? I happen to believe that pollution, widely defined, is one of the most important problems this country is facing. I also think that waste management or putting things in the ocean, is something that this country is going to have to face up to as we more and more contaminate our ground water, have more concerns with atmospheric air pollution and these kinds of things, I believe that the pressure is on to essentially look once more at the ocean as to whether or not it can indeed assimilate certain amounts of waste if done properly under the right kinds of conditions and so forth. I don't think we can wait for the Nation to make up their mind that this might happen. I think it is imperative that NOAA and EPA develop significant programs in this area. And the NOAA part of the pollution program, as I understand it, has been cut back almost completely, so that's one area.

NASA is putting on a major—is beginning to gear up for a major effort in ocean satellite work. As Dr. Hosler pointed out, it's one of the exciting new programs——

Mr. SCHEUER. Will the witness yield?

Dr. KNAUSS. Certainly.

Mr. SCHEUER. On your suggestion that we ought to be investigating whether the ocean has the potential of absorbing some of our waste, several years ago this very subcommittee that you are addressing now, established a multidisciplinary research program between EPA and NOAA to investigate exactly that subject. To investigate which method of waste disposal is less environmentally degrading—disposal by burning, incineration—calculating the polluting effects in the air—or disposal by ground—landfills, with all the problems of seepage and infestation of the ground waters that almost every Member of Congress suffers in his district, and ocean disposal. And we did that in connection with a court order that the EPA got stopping New York City from any further disposal of waste in the—in that little—in that bight——

Dr. KNAUSS. In the New York Bight.

Mr. SCHEUER. In the New York Bight, and we said look, what is the least environmentally degrading way of doing it and we ended up giving them a line item budget for a multidisciplinary study to investigate the comparable degrading effects of waste disposal by these three methods and they have just come in. EPA is coming in with regulations that permit disposal of waste at the 106-mile point, indicating their conclusion that disposal at that point was justified by the fact that the ocean could absorb it better than the ground and better than the atmosphere. So, we're right on target with your recommendation, in fact we may have anticipated you by a year or two. I'm very proud to say that and I'm proud that this committee has made such an important difference. Bob, my remarks are not coming out of your time. You take such time as you may need.

Mr. SMITH. I don't know if you finished your answer, did you?

Dr. KNAUSS. I can say more, but I think I probably said enough at this point to give you some ideas.

Mr. SMITH. I think that the concern—I'm trying to put this thing together in my own mind and believe me it is not—I happen to be Republican, but it's not an attempt to condone what has been done here, believe me. My concern is there seems to be a lot of competition for the ocean research in the Federal Government and what I'm concerned about is, are we, you know, are we doing things—obviously, we're doing something wrong here. Either there are too many people competing—too many agencies competing for this and it's not coordinated or perhaps what you're saying is whatever—what's being done elsewhere is fine, but we need to do more with NOAA. And I guess what I'm trying to get at is, I know you started to answer it, but what, you know, what aren't—what is NOAA capable of doing that they're not being allowed to do because—I mean apparently you're saying the other agencies are not doing it?

Dr. KNAUSS. Well, I think Dr. Hosler made a point that for example much of the expertise in the oceans and in the atmosphere is in the NOAA laboratories or at least in the NOAA infrastructure that they have available to them. And yet other agencies become—begin to take the lead in such areas as carbon dioxide research, you know, the greenhouse effect, acid rain and these kinds of things where the meteorological expertise is in NOAA. A lot of the pollution, the oceanographic expertise is in NOAA, not in EPA, but yet NOAA is being squeezed out of the—of that area of research. NOAA has had, traditionally, a large amount of expertise in studying ocean circulation and problems of this nature. Not exactly—not that they aren't doing that, but again they can't play the role that they could.

Mr. SMITH. If I could just interrupt you for a second. In another area of the budget there's a huge increase in acid rain research, so you know, in trying to look at the budget and do what's right in terms of the environmental issues, where are we wrong here? What's going wrong here?

Dr. KNAUSS. For people—for us on the outside it looks like that for whatever reason NOAA is not thriving in the Department of Commerce. Presumably maybe it's an overly simple-minded statement on our part or my part that—but the problem seems to be right there within the Department of Commerce. That's how I see it anyway. Or maybe with the OMB budget examiner who examines the Department of Commerce's budget. The way in which that works is not clear to me. The details of how that works. My—I know some people think that NOAA just can't survive in the Department of Commerce. My feeling is that it can't seem to survive during this period in the Department of Commerce. It has done quite well at other times in the Department.

Dr. HOSLER. May I interject here. I think that again we have a history in Government of moving this—well, take acid rain for example, of moving them around from agency to agency without the logic of where is the expertise or where should the expertise be developed—and from the outside again locking in, that program has been very disjointed. Again you have to look at a whole system to solve the acid rain problem. Some of it is atmospheric in the traditional sense, looking at where things go, the circulation and the dispersion of things. Others of it are—others are atmospheric chemistry, others of it are plant pathology, other parts of it are plant pathology. One has to put together a program drawing on the expertise of a number of organizations in a very coordinated and well thought out way whereas there has been a tendency to throw a big wad of money at one agency, for whatever internal reasons it arrives in that agency, whether it's the strength of committees in the Congress or the strength of people's pitch at the agency level, but from the outside again it doesn't—we don't have a program really in acid rain. In the sense that you could mount a program using all the internal and external expertise. It is not thought out in a system sense and again, from the outside it's very discouraging.

Mr. SMITH. You know it's like for example, EPA—the EPA budget had—I believe, a 23-percent increase in acid rain research. A lot of us would feel we've done quite a bit of research, it's time to get some implementation legislation here, but—especially when you live in New Hampshire and New York, as the chairman and get a lot of this stuff dumped on you every day, but I—it's just very difficult. Now, you've got almost 30 percent—roughly a 30-percent cut and yet in—if acid rain research can legitimately be removed from your domain and go somewhere else or if it belongs in your domain then these are the kinds of things that I'd like to know.

Dr. HOSLER. The point is NOAA does have some work going on in acid rain.

Mr. SMITH. How many areas of research in acid rain do we need and how many agencies—I don't know. I'm trying to say, do you need more coordinated effort or——

Dr. HOSLER. Well, there are interagency coordinating committees in all of these areas we've been talking about. Unfortunately the leadership seems to be lacking again, in that each agency comes in and defends its little piece of the pie and isn't really looking—no one is looking at the overall program—and how well these things mesh. So that many times when these interagency committees meet it's just to share—it's sort of show and tell what we're doing, rather than a center of coordination to instigate collaboration to focus on a problem. Many of us in the scientific world are sort of goal-oriented, management-by-objective types. You look at what your problem is. You assemble the best team you can to solve that problem. Whereas sometimes these things are looked at down here, it seems to us, as more of what little piece of the turf do we need to protect—protect our lab or our personnel, rather than problem orientation.

Mr. SMITH. I think—just a general comment that's not meant specifically at your domain, but it's an area of frustration that I feel sitting here as a Congressman and it's threaded through both of your testimonies, that, you know, providing *x* number of dollars today saves so many millions of dollars in the future and I think that's true. I've heard that, you know, I served on—in local town government, I served in local school board and we were always making decisons, you know, put this in, that in and save millions—build something now, save millions later, get this back, that back, but it never happened that way. At least it doesn't show up. You know the budget always goes up. The increases are always there and you still spend more dollars, so that argument, although I believe it's valid, doesn't—it's very hard to pin that down when you're trying to speak to those that you represent. And I wonder if you could comment on that because--what is wrong in the budgetary process? Why is it that we don't see that? Is it that we just continue to put the dollars in and continue the rate of growth in these programs that they never cease, that their work is never done, so in effect that argument is not valid? It's just that no matter how much you get back, as an example in the school board we implemented this—I can't think of—a computer is what it was, to save money and electricity and we were going to save hundreds of thousands—we did, we saved thousands of dollars, but the electricity cost still went up. We didn't save, you know, and the taxpayers still, you know, it's the cost of electricity went up, so what do we say. You know when you look at these kinds of things people begin to be a little cynical about it. And you know every single agency, you're not the exception, and I'm not critizing you, says the same thing. I believe that it's true, but still you don't seem to see the fruits of that. We still have a $230 billion deficit and $2 trillion national debts and on and on and on and on and the part that frustrates me is I want to help in this area because I think it's one of the most important areas this Government can be into, no question about it, you know groundwater, acid rain, clean air, water, and ocean research and all those things and yet this area and education and others of these, you know, you're looking at 20 to 25, at the outside 30 percent of the budget. The rest of it is entitlements, defense, and interest on the national debt. We can't cut it all here. We shouldn't cut it all here, but sometimes because Congress doesn't have the courage, if I might say, to get into the other areas or feel that they can't get into the other areas this is what winds up being on the limb all the time.

Dr. HOSLER. Sure, well you'll never satisfy the scientists. I mean veils are constantly being taken away from our eyes and we see new opportunities all the time and we're also shooting at moving targets.

Mr. SMITH. But, if you have a scientist as an administrator they say he's a good scientist, but he can't administrate. The other way around they say the same thing. Is there anybody out there anywhere that has both qualities?

Dr. KNAUSS. Oh, yes. There are some. There are two sitting at this table.

Mr. SMITH. That's good. I'm glad to hear that. You can comment if you like, it was just an observation.

Dr. HOSLER. Well, I sympathize with you who have the trouble of maintaining budgets for their school committee or in Congress, but there are certain things that are growth industries, gerontology, you know, there are certain things that have happened. We all live longer and so clearly that's—and we're going to have to live with the fact that people are going to have to spend more money and worry about how we take care of old people. That's going to be a growth industry for a long time. Pollution, God forbid, is a growth industry and because our standard of living is going up all over the world, there are more people all over the world. We aren't going to solve the pollution problem. That pollution problem is going to be with us until your children are long dead. It's going to continue to grow and we're going to have to spend money on that problem.

Mr. SMITH. But one of the criticisms I hear back in the district is that America is trying to do it all. In other words the ocean is an international problem.

Dr. HOSLER. Yes.

Mr. SMITH. And you know, how much help are we getting at the international level or should we be getting at the international level?

Dr. HOSLER. Well, in some fields we're getting a lot.

Mr. SMITH. Everything we do could be undone by somebody else, is the point I'm making.

Dr. KNAUSS. Well, as far as ocean pollution is concerned there is a London Dumping Convention, an international convention to which we are a party to along with 60 other nations which we've played a strong part in establishing and it does put certain bounds on what people can at least consciously dispose of in the ocean.

Dr. HOSLER. I guess philosophically I agree with you. We can't—there are days when I realize we can't do it all and take care of the whole world and feed them and clothe them and so forth, but in this case, in the meteorological case and in the oceanographic case, in my opinion, it is in our self-interest to increase productivity in our economy, whether it's in agriculture or in harvesting the sea or whatever, and it's in our interest to protect ourselves from the pollution that we may be generating. We may not be able to stop the Chinese from creating acid rain, but at least we may be able to do something to alleviate the problem here. So, I think you don't have to go international to see the benefits of the research and the operational programs that NOAA is in charge of here in this country. So, I think it's in enlightened self-interest to see that these things advance. Now, I would be the first to admit you can do these things at different paces. I mean you can do it in another $500 million a year or you can do it at another $100 million a year or even at the present pace you'll make some progress, but it's simply a question of how long do you want to wait until the people in Tulsa get that 30 minutes extra warning or the people in New Hampshire get that extra 30 minutes on a flood forecast, those are—of course that's why you're elected and you're down here, because of presumed wisdom in these things and you've got to make the decisions. We can put the options in front of you, but it's a tough decision that you've got to make and I realize you've got hundreds of budget items just like this coming up.

Mr. SMITH. Just one quick comment, Mr. Chairman. I think the frustration is, you know, I know the chairman is from New York and I'm from New Hampshire, you see the lakes, you know what is happening, you know the fish are dying, you know the trees are being defoliated and you—and I discussed this when it came up earlier in another meeting, another hearing, 23 percent increase in research on acid rain and people get very cynical about it with me. They're very impatient about it, the environmentalists say how much damn more money are you going to spend on research before you implement something and I think—it comes—it makes research look bad if you don't, you know, at some point in time try something to find out whether or not it's going to work and that's where I—you know, nobody, as I said before, I'm a hardcore conservative on the budget, but I'm also an environmentalist and I get very impatient with these things. I don't understand why we can't implement some of this stuff and you know, and somebody says well, I'm not sure it's the Midwest smokestacks. Let's find out. All we have to do is stop them from putting the stuff in the air and we'll know damn soon whether or not it is.

Dr. **Hosler**. Well, I proposed that experiment. It hasn't been very well received.

Mr. **Smith**. I'm with you.

Dr. **Hosler**. But——

Mr. **Smith**. It won't take long to find out.

Dr. **Hosler**. The fact is I'm probably pretty close to you philosophically and politically, but I would have to say that as I've looked at the acid rain problem there are some big question marks in my mind whether you spend billions a year to take the sulfur out and you might wind up at the end of ten years finding out you did nothing. There is a very distinct possibility of that in my opinion.

Mr. **Scheuer**. Will the witness yield?

Dr. **Hosler**. Yes.

Mr. **Scheuer**. Are you familiar with the incident of the Sudbury plant?

Dr. **Hosler**. I certainly am.

Mr. **Scheuer**. Well tell us about that.

Dr. **Hosler**. That was sulfur dioxide I believe.

Mr. **Scheuer**. Yes and they had a strike and they closed down for 6 months and, now you tell us the end.

Dr. **Hosler**. I don't know, you tell us.

Mr. **Scheuer**. Well, as I recall it, this was the single greatest polluting plant in the world. They had a smokestack about 1,250 feet high and they had a strike and they closed down for 6 months and all the environmental monitoring—the whole environmental monitoring system was barely able to detect that it closed down.

Dr. **Hosler**. That's right. Yes, and in the acid rain thing I'm sure you weren't able to detect it at all. If you realize, sulfur——

Mr. **Scheuer**. That's what I mean, when it came to detecting any reduction in acid rain there was absolutely no empirical evidence that closing it down had any effect in reducing the output of acid rain. Now maybe the whole question of acid rain transport is so complicated that we weren't able to detect the very real effects that did take place. But this certainly has given me and several of the other members a big fat question mark.

Dr. **Hosler**. Well, in the last decade the acid—the sulfur emissions in this country have gone down something on the order of 34 percent because of improved plants and so forth and yet there is no evidence that that has had any impact at all on the acidity of rain. If you look at the plots, whether it's for Washington, DC or in the Adirondacks the fact is that it's just a very highly variable thing with no discernible trend up or down. There are many other factors, the amount of unburned hydrocarbons put into the atmosphere that influences the amount of oxidents available, the amount of oxidents that are necessary to oxidize the $SO_2$ into sulfate to produce the acidity is highly variable and, as you say the wind is variable. There are about 75 chemical reactions that we've identified in the atmosphere that can contribute to the acidity of rain, which are—which have entering into them chemical components of a very diverse nature and both natural and man-made processes, so I don't expect rapid conversions on an agreed solution to this problem. I must confess that there obviously are some observable effects on lakes and so forth, but I can't tell you how to solve it.

Mr. **Smith**. See, we're not—most of us are lay people and we try to make budgetary decisions based on the technical input that comes in through these hearings and what—Dan just pointed out to me a very interesting point. The committee on acid rain is chaired by NOAA, as I understand it, and yet EPA got a 23-percent increase in research in acid rain. Now, that's the kind of stuff that I don't understand. I don't understand that kind of inconsistency and I—and it seems to me we're dumping money, you know, you dump money in a barrel, if there is a hole in the bottom of it you can keep on dumping and then you're not going to get anything out of it and this is the part that bothers me. I don't think we're coordinating our efforts properly. I sense, and I've only been here 3 months and the chairman has been here a little bit longer than that and I sense already a lot of interagency friction, especially in this area. Somebody mentioned, I think it was somebody from NOAA mentioned a short while ago some hard feelings between them and the Defense Department over the mapping of the oceans. The Defense Department feeling, you know, it was a violation of national security to release it and them saying, well, you know, we've got to have it and this is the kind of stuff that frustrates you. I think our money is not being—and the resources are so limited I think somehow we need to keep some coordination.

Dr. **Hosler**. Certainly the coordination needs to be improved, but I would also say you don't need to apologize for being a lay person in an area like acid rain because those of us who have looked at it in more detail are still lay persons. We are so ignorant compared to the complexity of problems with this that we all, while we may have scratched the surface a little more deeply than the man on the street, it's not that much more deeply and—but I for one am conservative in a number of respects and one is I don't think we ought to launch any huge disruption of whether it's the power generation industry or any other industry at this point, based on what we know at this time in the area of acid rain, but we sure as heck have to look at it in a coordinated and sensible way.

Mr. **Scheuer**. Let me just say that on April 3, Bob, we're having a hearing on acid rain in which all of the agencies are going to be up here to testify and this is going to be a great opportunity for all of us. We are running terribly late, but I just can't resist echoing Bob Smith's thought that we shouldn't wait until we know everything before we do anything when it comes to acid rain. We don't do that in any other part of our life. We operate on imperfect data bases on almost every action we take, in our home life, our business, or whatever and the—the necessity to do something about acid rain certainly ought to compel us to decide if there isn't some minimum level of regulation that is cost effective, that is sensible, that is not wasteful, that does not impose unnecessary burdens on industry, that will at least dissuade the problem to some extent while we continue to research to see whether more expensive, high tech answers are there in the offing that are also cost effective.

The danger is that we just keep using this research as a palliative, as the opium of the people and the Congress and we defer any ameliorative action until we know everything and of course we'll never know everything.

Dr. **Hosler**. The tobacco industry is a good example. They need more research too.

Mr. **Scheuer**. Exactly.

Dr. **Hosler**. But I think that I would like to indulge you just one bit to say that we are improving the sulfur emission problem with time as new power plants go on the line and new control devices go on line and if the congress were to do anything in this area I think it would be to—Whether it's through tax incentives, incentives or whatever ways you can derive to get this modernization going at a greater pace in order to continue this trend, the downward trend. I don't think anyone would argue that sulfur dioxide is good for us or good for anything and so I think we should reduce it, but there are ways, through new combustion techniques, through new cleaning techniques of coal and through stack control techniques of gradually eating away at this problem over some logical and sensible period of time. And I think we can clear it up, maybe not in our lifetime, but certainly in our children's.

Mr. **Scheuer**. Congresswoman Jan Meyers.

Ms. **Meyers**. Just a really quick question. There have been substantial cuts in the NOAA budget, if you could—and I think maybe Bob began to touch on this, but if you could just restore a portion of those cuts, what would be maybe your top priority? Or your top two priorities?

Dr. **Knauss**. Oh boy, I feel very uncomfortable in talking in that level of detail about a budget that I—about a program that I don't know in detail because I don't know the programs that carefully. I know quite a bit about the Sea Grant Program. I think restoring it is cost effective. I think it's a very good program. I am concerned about the cuts, as I said before, in the—if it is indeed true, as I think it is, the major cuts in the marine pollution work of NOAA because I think that is a long-term problem that we have to deal with. I am concerned about the ability of NOAA to be prepared to make use of the ocean satellite information that will be coming on line in a few years as NASA's program goes forward. NOAA will have a very important role to play and I've been told that their—that NOAA has not been able to essentially get that kind of program underway.

That's anecdotal. I get upset when people from the outside give me specific advice on how I should run my program, if I have to make certain cuts, and I feel very uncomfortable about telling Tony Calio what he should do in any detail, but that, from where I see it that would give you some hint as to where I'm coming from, yes.

Ms. **Meyers**. I think sometimes it's good to get others priorities too. Dr. Hosler, would you——

Dr. **Hosler**. Yes; I—oceanographers are more conservative than meteorologists. I'll venture to make a couple of suggestions. One is the operational budget for the national weather service has been cut to the point where it has really hurt morale and the manpower is very thin and I think the country's—the service, the weather service we get is being diminished by the cuts as deep as they have been. The second thing is I think the NEXRAD Program, that stand for next radar, this new horizonally pointing Doppler radar. It's extremely important that we get those deployed and I think at a greater pace than is postulated in this present budget. And the third thing would be to get the research program called Storm, Storm Central, which would be the deployment of both NEXRAD's and the vertically pointing wind profilers in an experiment to get a data set that would enable us to do the mathematical modeling to increase the precision of these short-range forecasts, which whether you're pouring concrete or mowing your lawn or cutting your hay or going on a vacation are very important to the man in the street and to the everyday operations in this country. The slowdown in NEXRAD was very disturbing to me because I think the payoff there is tremendous and I can assure you again that I talked to weather service personnel and people in the meteorological community and morale, based on the cuts in personnel and their frustration at not being able to do the job and protect the people in the way the service was chartered to do, that frustration is very deep at the present time.

Ms. MEYERS. Well, I come from Kansas. I appreciate both of your concern for that extra 30 minute warning you're going to give us.

Mr. SCHEUER. Well, the fact that we went so far over planned time for this, for the two of you, indicates how fascinating and thoughtful we found your testimony. We thank you very, very much.

Dr. HOSLER. Thank you.

Mr. SCHEUER. All right. We'll now move on to the last witness on the Weather Satellite Program, Mr. David Johnson, president of Damar International, Inc., and former assistant administrator for satellite programs of the very NOAA that we're talking about. We're happy to have you here, Mr. Johnson.

Mr. JOHNSON. Thank you, Mr. Chairman.

Mr. SCHEUER. Our time is running a little bit short. We're going to have a vote on the MX missile at 12:30; we can stay another 6 or 7 minutes into the vote, so I hope what you will do is chat with us, hitting the highlights of your testimony, for not more than 5 or 6 minutes, and then give us the opportunity to ask some questions, and I will submit my questions to you for the record by mail and enable my colleagues to have first crack at you in deference to the fact that I've probably taken more time than I should have in the first two witnesses. So, please proceed as you wish for about 5 minutes.

## STATEMENT OF DAVID S. JOHNSON, PRESIDENT, DAMAR INTERNATIONAL, INC. AND FORMER ASSISTANT ADMINISTRATOR FOR SATELLITE PROGRAMS FOR NOAA

Mr. JOHNSON. OK, I have prepared a summary of my submitted testimony, but I'll even summarize the summary.

Mr. SCHEUER. Good.

Mr. JOHNSON. I've been before you before and I really regret having to come back on the same subject. I believe this is the fifth time now in a row where it has been proposed to reduce from two polar satellites to one polar satellite. The main problem with that reduction is that it removes the reliability of the system. There is a very major threat that will develop that there will be an interruption of several months, due to either a launch failure or spacecraft failure. I note, in the NOAA budget, that the budget itself indicates an average saving of only $11.6 million per year over a 12-year period from 1985 to fiscal 1997. And it seems to me that that's a very, very small saving indeed with the potential impact of a unreliable service on which the whole world now depends. I quote in my testimony both the Secretary General of the WMO, who appeared before this committee a couple of years ago.

Mr. SCHEUER. For the record that's the World Meteorological Organization.

Mr. JOHNSON. Correct. It's an international agency, intergovernmental, specialized agency of the United Nations. There are more than 150 nations and territories that are members of this organization. It is through that organization that we exchange weather data throughout the world. You've already indicated the tremendous impact and Charlie Hosler has, of the Weather Satellite Program on other nations and particularly the developing world. In fact there are some very small island nations where the weather satellite provides essentially all of their weather data that they use to give them eyes to see storms. They look at the pictures and based upon seeing the storms in the cloud patterns they're able to initiate warnings that they otherwise would not be able to make. The Ninth Meteorological Congress of the WMO, in its last meeting, indicated that they considered the current operational satellites to be absolutely essential for the performance of what is called the World Weather Watch. It's a global system of many satellites, not all of them from the United States, and ground observations that are used by all of the nations of the world to produce better weather forecasts and warnings.

We've also heard about SARSAT, which requires a reliable platform and needs two satellites actually in operation most of the time. In testimony before the Senate subcommittee this last week the SARSAT Program manager of NASA indicated that NASA was investigating the possibility of building a dedicated SARSAT satellite because of the proposal of NOAA to reduce from a two-spacecraft system to a one-spacecraft system. I can't help but wonder how much that would cost compared to the savings that are indicated in the NOAA budget.

I think that if you look back at the record of the polar satellites it's fairly easy to see that it's very highly probable there would be an interruption of service with a proposed one-spacecraft system. I note that we've had one launch failure in the period since the current series of satellites began in 1978, late 1978 and if that were to happen again, that is a spacecraft in orbit failure followed by a launch failure, then this proposed one-spacecraft system would leave a gap of many months before it could be restored. I think, Mr. Chairman, because of the shortness of time I will stop at that point.

[The prepared statement of Mr. Johnson follows:]

Testimony of
David S. Johnson

to the
Subcommittee on Natural Resources,
Agriculture Research and Environment

of the
Committee on Science and Technology
U.S. House of Representatives

March 28, 1985

Mr. Chairman and members of the Subcommittee, I am pleased to be asked to comment on the proposed NOAA budget for FY 1986 as it relates to the nation's weather satellite program. As the former Assistant Administrator of NOAA for Satellites, I have a continuing interest in the subject. Since retiring from NOAA in 1982, I have worked as a consultant and (until 1983) as a special assistant to the President of the University Corporation for Atmospheric Research, a consortium of 50 universities. During the past three years, I have served as a consultant to the Secretary-General of the World Meteorological Organization (WMO), a specialized agency of the United Nations, involving more than 150 nations and territories. Thus, I have had an opportunity to broaden my view of the importance of the NOAA satellite program to research and the international community as well as in meeting U.S. operational needs.

Although my comments today reflect my personal views and not necessarily the views of the organizations with whom I have worked, I think this experience has given me a unique perspective from which to view the NOAA satellite program and the potential impact of the 1986 budget on the world wide users of its products. In particular, I have been asked to comment on the Administration's proposal to reduce the NOAA polar orbiting satellite system from the present two-spacecraft system to one.

In summary, as I said when I appeared before this subcommittee two years ago, such a reduction would be disastrous, not only to the weather services of the United States, but to the many nations of the world which have become dependent on this important source of global weather data. And for what savings? According to the NOAA budget request for FY 1986 (p. NOAA-124), the proposed one-spacecraft configuration will save only an average of $11.6 million per year during the 12 year period, FY 1985-1997, compared to the present two-spacecraft system. Why take the large risk of an interruption in services for such a small saving, especially at a time when we have the capability to improve global long range weather forecasts, the need to determine man's impact on climate has never been greater, and a highly reliable, successful international search and rescue program has been established, all applications which are absolutely dependent on the continuity of the polar-orbiting satellites.

The compelling reason for a two-satellite system is not the increased data available from the double coverage, valuable as this may be. The primary need is for in-orbit back-up. With two satellites in orbit, when one fails the other is immediately available to continue global coverage. Today, when one of the polar orbiting satellites fails, a replacement satellite is called up for launch. With the expendable launch vehicles used today, the replacement time is a minimum of four months. However, this time delay will be several months longer when the Shuttle is used. By launching a replacement satellite when either of the two on orbit have failed, the U.S. has been able to maintain at least one polar-orbiter in operation at all times, even when there has been a launch failure.

The new plan proposed again in the FY 1986 budget calls for a launch on a fixed schedule, one every 18 months. Thus, if there is a premature failure of a NOAA spacecraft in orbit - and there has been in the past - or there is a premature failure of a spacecraft followed by a launch failure - which also has happened in the past - there would be a complete cessation of global satellite coverage for several months to a year and a half or more.

The polar-orbiting satellites make important contributions to weather forecasting. They not only cover the entire earth including the polar regions, but provide vertical temperature soundings of particular importance to advanced computer weather forecasting. The Administration proposes that these observations be provided by the geostationary weather satellites. They cannot be. The Geostationary Operational Environmental Satellites (GOES) of the U.S. are equipped with temperature sounders also. However, they cover only a part of the Western Hemisphere. And today, because of premature spacecraft failures only one GOES is still operational. This one remaining satellite may very well fail before a replacement GOES spacecraft can be completed by the manufacturer and launched. Thus, there is a very high probability that there will be no geostationary satellite coverage in the Western Hemisphere later this year. In addition, only the U.S. geostationary weather satellites are equipped with temperature sounders. This means that the polar orbiters provide the only means of obtaining these essential data for two-thirds of the world, even when both GOES satellites are fully operational.

There is a further complication. Present temperature sounders, on both the polar- and geostationary-orbiting satellites, use infrared detectors to sense the temperature of the atmosphere. The problem with infrared radiation is that it can not pass through clouds. Therefore, today's operational sounders are blind in cloudy areas which often are associated with storms. This has led to plans by the National Environmental Satellite, Data, and Information Service of NOAA, and the Meteorological Office of the United Kingdom to introduce the Advanced Microwave Sounding Unit (AMSU) on the NOAA polar-orbiters. With microwaves, the sounder will be able to provide these essential data in cloudy areas as well as clear. I note that the FY 1986 budget request for NOAA proposes, related to the one-spacecraft proposal, a rescission of $5 million appropriated in FY 1985 to begin development and construction of the U.S. portion of the AMSU. Unfortunately, today's microwave technology cannot be used from geostationary orbit because it is about 40 times farther away from the earth than the polar orbit. Thus, the effort to add the AMSU to the polar-orbiters should be continued and for all these reasons the GOES satellites cannot be considered a suitable backup to the NOAA polar-orbiters.

The Administration's proposal to cut the polar program threatens the collapse of this key element of the global weather observing system, with potentially catastrophic results. For example, we could have zero atmospheric sounding coverage of tropical disturbances in the eastern Atlantic Ocean from which our hurricanes are bred. Wintertime storm centers in the Arctic would go unobserved. The whole international weather monitoring program would be compromised, especially the remote atmospheric sounding measurements made from space and the location and collection of data from drifting ocean buoys, balloons, and other automatic observing units in remote places.

The gaps in the global data base will not only impact operational weather forecasting but major research programs, such as the Global Climate Program, as well. The recommendations to the National Aeronautics and Space Administration (NASA) by the Science and Mission Requirements Working Group regarding NASA's proposed Earth Observing System (NASA TM 86129, August 1984) states:

> "The now operational land and meteorological satellite systems have provided over a decade of observations many of

> which are crucial to the research questions confronting us. The first step must be to ensure that these key observations are preserved. The second step is to provide improved access to these data for scientific purposes. Third, a capability at least equal to the present (operational) system must be continued. Based on the foundation of these three steps we can examine what improvements and new systems should be undertaken."

This statement clearly indicates the pivotal role that the continuity and capability of NOAA's operational satellite system plays in research, and should play in NASA's space development program.

About 125 countries around the world have more than 1000 ground stations to receive data broadcast directly from the NOAA polar-orbiting satellites. In many developing countries, these data represent the primary source of regional weather observations. The sounding data I mentioned earlier are used world wide in computer weather models which provide basic forecasts of weather systems everywhere on earth. This is part of the World Weather Watch operated under the aegis of the World Meteorological Organization (WMO) by its Members. Because of the importance of satellites, the Ninth World Meteorological Congress of WMO (1983) adopted a resolution which included:

> "(1) That due to technological developments during the last decade polar-orbiting and geostationary meteorological satellites have emerged as a vital component of the World Weather Watch and play a critical role for the meteorological and hydrological operational services provided by Members at the global, regional and national levels,

> "(2) That the continued operation of meteorological satellites, both polar-orbiting and geostationary, in their observation, data collection and dissemination roles is essential and must be ensured if the World Weather Watch system and the related applications are to be preserved."

Thus the proposal to change the U.S. operational weather satellite system is not a domestic issue only. Indeed, the Secretary-General of the WMO, in his testimony before this subcommittee on July 21, 1983, concluded with a request that,

> "...in your deliberations you also consider two other items. First, the contribution that the USA satellites make to the global network of meteorological satellites, and second, the importance of maintaining that global integrity to the health and safety of all persons on the Earth. From the global perspective it seems to me that the fundamental problem we now face is therefore how do we assure the continued and reliable operation which will provide at least the existing capability to the worldwide user community. In order to define an approach to solving this high priority problem of operational continuity, we need to identify acceptable and practical means for nations to contribute to a co-operative system on a global scale."

In conclusion, I believe that the U.S. can afford an average of $12 million a year to continue the present system when one considers the overall budget, priorities and international roles of the Federal government, and not just those of NOAA alone. Also, the importance of the Advanced Microwave Sounder Unit to improved performance in cloudy regions should not be overlooked. I trust that the wisdom of the Congress which has been demonstrated regarding this proposal in previous years will continue to prevail.

Mr. SCHEUER. Very good. Bob Smith.

Mr. SMITH. I have one question. Do the Soviets have polar orbiting weather satellites?

Mr. JOHNSON. Yes, Mr. Congressman, they do.

Mr. SMITH. Do they share any of that information?

Mr. JOHNSON. They share it. Unfortunately it is not anywhere near the quality of our satellites and we get the data quite late. The primary data that we get from the Russian satellites are pictures and we, fortunately, have many pictures not only from our satellites, but from the satellites operated by Japan, Europe and India. What we need, and what is most important, as I indicated in the testimony, are the measurements that tell us what temperature is in the atmosphere from the surface of the Earth out to space. The Russians so far have not been able to develop and launch an adequate instrument for measuring those temperatures; only the United States has so far been able to do that.

Mr. SMITH. What about receiving contributions from countries who, we can call them user fees, whatever you want to call them. What about that, is that a possibility?

Mr. JOHNSON. Well, I think if we're talking about user fees that leads to a very, very serious question, which has been considered in past years. At the present time all weather data from all the nations in the world, regardless of their political persuasion are exchanged free of charge; no matter who takes the observations or who's paying for them, they are exchanged internationally. The United States now gets observations, say 1,000 upper air sounding observations from other nations of the world, in exchange for what we provide.

Now, there is cooperation and exchange of things, of material, among various countries. Of course the wealthier countries are providing instruments and help in training to the less developed world. In the case of our present polar satellite program, the United Kingdom provides one of the sounding instruments that is flown regularly on the U.S. satellite. France provides another instrument that is flown regularly on the satellite and the SARSAT, as has been mentioned is a cooperative program between France, Canada and the United States. That is the equipment that's flown on our satellites, is a cooperative effort. Other nations provide other kinds of satellites. The so called geostationary satellites, similar to the one that produces the cloud pictures you see on the evening weather show, Europe operates the METEOSAT, India the INSAT over the Indian Ocean and Japan the GMS over Eastern Asia and the Western Pacific. There are a total of five of them, two of which are provided by NOAA, the GOES satellites; the other three are provided by other countries and funded entirely by those countries.

The problem with user fees is if you start to sell satellite data, polar satellite data you have to establish some fee system according to ability to pay from the smallest country, say the Seychelles, to the largest country. Then those countries are going to say, well, if the United States is going to charge for those data then we'd better start charging for our data as well and that could lead to some very great difficulties. I would propose, instead, that we press ahead, as has been done recently, with trying to increase the international collaboration in expensive programs like the Satellite Program. That is, getting other countries to provide more of the instruments that are flown on these platforms. I know that Dr. McElroy, in NOAA, is investigating this with other countries at the present time.

Mr. SMITH. Thank you.

Mr. SCHEUER. Congresswoman Jan Meyers.

Ms. MEYERS. No questions, Mr. Chairman.

Mr. SCHEUER. Mr. Johnson, you say on page 6 of your testimony that 125 developing nations utilize the polar-orbiting satellites. Tell us how they use them and how they depend on them and what would be the result of failure of one of them in terms of interruption of the service? What would be the economic and social impact on these nations of a complete shut-off of the weather—the weather information that flows from the polar satellites, if we had to rely on a one-satellite system and that was a failure?

Mr. JOHNSON. Well, I think that if you have a single spacecraft working up there instead of two there would be some degradation in the quality of weather services, but it wouldn't be a disaster. The disaster will occur when that lone satellite fails and you may have several months or a year or more to get a replacement up. That means that many of these smaller developing countries will have essentially no weather data for adjacent ocean areas at all. They will become blind. Just as if you were to rely only on looking at clouds and somebody blinded you, put a blindfold over your eyes, you no longer could observe the clouds and say what's happening. So, I think it would become a very serious and difficult situation for a large part of the world if that were to happen.

The economic impact, of course depends on the quality of life and the level of economic development. One example that I can think of is in Bangledesh where they are troubled with cyclones. They are similar to our hurricanes that go up the Bay of Bengal. The U.S. Agency for International Development has worked in the past with that country in establishing a satellite receiving facility and analysis facility to get the pictures from our polar-orbiting satellite and an infrastructure in the Government to be able to issue warnings. How many people this would save, I don't know, but there have been occasions in the past where they did not get the satellite data out, where as many as 100,000 people were drowned. There are cases like this that can be ameliorated by the ability to receive these satellite images. Another application that's growing is in Africa where the same imager that produces cloud pictures can also be used to tell you about the level of vegetation, how healthy the vegetation is. One of the severe difficulties in Africa is predicting when the locusts are going to swarm and get aircraft out when they're little babies and spray them fast before they can wipe out whole crops. This is now being done, aided by using the NOAA satellite pictures received in Africa and being able to tell when you're getting green grass starting to grow out in the fringes, in the desert areas and with the proper temperature conditions, which can also be measured by the satellite. The biologist can say, ah ha, that is an area and time when you're likely to have locusts and they direct the aircraft out there to do the spraying.

Mr. **Scheuer**. Fascinating. You indicate on page two of your testimony that the second polar-orbiting satellite will only cost $11.6 million per year for the next 12 years, but OMB estimates that the additional cost in fiscal year 1986 alone is $82 million. This is a spectacular discrepancy. Do you have any explanation for it?

Mr. **Johnson**. Probably not a rigid explanation because I too, like Johnny Knauss, have trouble reading that budget. I can guess that it partially is due to the recission that is proposed in the budget. That is they're backing out a large sum of money in 1985 that was supposed to go to maintain the two polar orbiter, then they recalculate the base, so they're starting with an artificially small base in fiscal 1986 and that increases then the cost increment that you would have. In other words you have to make an adjustment for money that's already been appropriated by Congress. The second aspect is that they would proceed with securing some additional polar satellites in 1986 if you stay with the two polar system. So you have heavier funding up front. I believe there is another place in the budget where it shows that actually further out in another 3 or 4 or 5 years there would be a decrease in the budget below the current fiscal year 1986 budget projection, because you would have funded more of this up front and not have to fund it down in 1988, so there is a compensation effect. If you spend the money now you don't spend it later because you've already bought these things.

Mr. **Scheuer**. In terms of lifecycle costing.

Mr. **Johnson**. In terms of lifecycle costing then the $11.6 million, averaged over those years, is the difference. I understand that there has been an internal study made that indicates it may even be less than that.

Mr. **Scheuer**. That's interesting. NOAA is requesting $1 million in fiscal year 1986 for a detailed convergence study of a joint NOAA, DOD—for a joint NOAA, DOD requirements for weather satellites. In your opinion has anything changed since the last convergence study was done in 1978 to convince you and us that the DOD and NOAA systems can be merged to a more significant degree than was apparently thought possible at that time?

Mr. **Johnson**. I'm sorry, Mr. Chairman, but I don't know of any changes in circumstances. There may very well have been. I can say that the problem that has existed before is—deals with policy and not technology. And that is the question of the constraints that both the civil community and the military community place upon their systems. These tend to be incompatible. And that was really why no further convergence was possible on the previous two occasions that this was attempted. There was a conflict in policy and management between the civil arena and the military arena.

Mr. **Scheuer**. One last question for me, we're trying to deal with the awesome extent of this famine in Africa, famine that doesn't come so much from drought as it comes from very poor governmental decisionmaking and stupidity on the part of many of the donors as well as the recipient governments in terms of their failure to increase agricultural growth, production and their failure to do something significant to get a curb on their population explosion. What they have to do is achieve equilibrium between people and food. Let me ask, what kind of a contribution have the polar satellites made to the drought, to easing the conditions of drought and helping those governments find a way out of their inadequate food production programs?

Mr. JOHNSON. Well, I mentioned the case of the locust control, which has been improved. I know that the same satellite data, the same kind of data I described have been used and are being used in a sort of a climatology of vegetation for the entire African continent.

Mr. SCHEUER. Are these countries sophisticated enough to have sufficiently developed infrastructure of technical personnel, university people and so forth, to use the weather satellite data?

Mr. JOHNSON. Well, I'm sure it's highly variable from feast to famine. The FAO, based in Rome, does have a remote sensing unit that is very knowledgeable and includes both agriculturalists and remote sensing experts. I suspect that they're doing quite a bit, whatever can be done within Africa to assist them in using this information to try and make proper decisions. Again I think it's more of a case of the economic, social and political infrastructures in each of these countries, their ability to actually do something even if they're given the information. All we can do in the satellite area is to provide information, but somebody has to act on it.

Mr. SCHEUER. Yes.

Mr. JOHNSON. The World Bank is heavily involved in this same type of activity as well. There are a lot of organizations that are working in Africa. The World Meteorological Organization has teams in there. It's very highly populated with technical experts, but how much that really helps individual countries I don't know personally. I suspect it's very much variable depending on the nature of the governments in each case.

Mr. SCHEUER. Yes. My colleagues, Bob, Jan? All right. Well, thank you very much, Mr. Johnson, you have been here before, you've given us of your wisdom on a number of occasions. We hope we'll settle this matter so we won't have to keep asking you back, but we thank you for your counsel along this rocky path. Thank you very much.

[Whereupon, at 12:35 p.m., the subcommittee was adjourned.]

# APPENDIX

Opening Statement

Honorable Dave McCurdy (D-OK)

Subcommittee on Natural Resources,
Agriculture Research and Environment
Committee on Science and Technology
Hearing on NOAA FY86 Budget

March 7, 1985

I count myself as one of NOAA's strongest supporters among the members of the House. I am encouraged when NOAA's research programs give the folks back home a tangible benefit for their federal tax dollars. One such example is the upgrading of the weather systems used to detect severe storms across the country.

Severe weather is of great interest to me since my district in Oklahoma sits in what is known as "tornado alley." Any work by the Weather Service that helps protect the public against tornadoes, storms and flash floods is most welcome there. In fact, good weather detection should be of interest to every area of the country since any thunderstorm can produce a tornado similar to the dozens unleashed across the midwest last June.

A key part of NOAA's effort to upgrade weather systems is the Next Generation Weather Radar System -- know as NEXRAD. NEXRAD Doppler radar will render the 25-year-old units now in use totally obsolete. The NEXRAD nationwide system will make it possible to warn the public 20 to 30 minutes before a storm strikes. NEXRAD will help warn military and civilian aircraft of microbursts and windshears. NEXRAD will be useful for water management and flash flood prediction.

Weather experts in my state tell me that NEXRAD can save our country from $90 million to $360 million a year in property damage -- not to mention the hundreds of lives saved because the public had time to "take cover."

Despite these and many other benefits to be derived from modernization, the NOAA budget submitted would postpone work on NEXRAD. In FY86, NEXRAD funding is reduced dramatically. OMB would put off plans to build a NEXRAD prototype so that NEXRAD can be compared "off-the-shelf" doppler radar. Depending on the results, NOAA will proceed with NEXRAD or buy these off-the-shelf models.

We cannot afford this delay; it simply is not in the best interest of the people that NOAA seeks to protect. Postponement does not save lives and property. Postponement costs the program $60 million to $80 million a year. Why, after years of developing a program that meets DOD, FAA and NOAA specifications, would we want to switch to a system that has shown it cannot match NEXRAD's "science?"

Mr. Chairman, I have a point-by-point comparison of the performance of NEXRAD with alternative systems that I would like included in the record with my remarks.

The NOAA disaster study-team that surveyed the Carolinas after tornadoes killed 57 people there last March urged "earliest possible" NEXRAD installation. A report by the Public Works and Transportation Committee last November said that NEXRAD "is a sorely needed advance in weather observation technology" for aviation safety.

Mark Twain once lamented that "everyone seems to talk about the weather but nobody does anything about it." I welcome any comments by Dr. Calio on behalf of NOAA that will disprove this old saying. Thank you.

COMPARISON OF WEATHER RADAR CHOICES

| ISSUE | NEXRAD | OTHER ALTERNATIVE | RESULT |
|---|---|---|---|
| BACKGROUND RESEARCH AND DEVELOPMENT | 13 Year Development Period<br>-Experimentation with basic radar since 1971 at NSSL[1], AFGL[2]<br>-Formal evaluation during JDOP[3]<br>-Years of computer software development<br>-Considerable prototype testing at many U.S. sites | Development Just Beginning<br>-Experimentation only since 1982<br>-No formal evaluation<br>-Essentially no computer software development<br>-Limited prototype testing at few U.S. sites | Alternative would take several years to complete development and verify if there is operational utility. |
| CHOICE OF WAVELENGTH | 10 cm | 5 cm | Alternative would have seriously degraded performance in the detection of severe weather and the identification of flash floods. |
| Attenuation | -None; accurate rainfall estimation from radar. All storms detected. | -Considerable; only a portion can be recovered by computers. Accurate estimation of heavy rainfall by radar not possible. Significant storms occasionally not detected. | |
| Useful Range | -230 km with simple signal processing | -120 km with elaborate signal processing | |
| Velocity Measurement | -Accurate velocity in short acquisition time | -Less accurate velocity in longer acquisition time | |
| Surveillance Capability | -Three-dimensional scan of all storms in 5 minutes | -Three-dimensional scan of all storms not practical due to longer acquisition time | |
| Manpower Utilization | -Considerable automation; labor savings while improving accuracies | -Limited automation; labor intensive, no labor savings | |
| ANTENNA SIZE FOR 10 CM WAVELENGTH | -28 ft. diameter | -12 ft. diameter | Detection of hazards limited in range due to poor sampling resolution of smaller antenna. Hence, alternative requires many more radars to achieve network comparable to NEXRAD. |
| Tornado Detection Range | -110 km | -40 km | |
| Mesocyclone Detection Range | -230 km | -120 km | |
| Storm Wind Detection Range | -75 km | -55 km | |

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[1] National Severe Storms Laboratory

[2] Air Force Geophysical Laboratory

[3] Joint Doppler Experiment

Continued on other side

| ISSUE | NEXRAD | OTHER ALTERNATIVE | RESULT |
|---|---|---|---|
| HARDWARE CHOICES | Elaborate Hardware | Simpler Hardware | Alternative would be less sensitive to weak echo everywhere, less reliable in stronger echo near radar and would be unavailable more often. |
| Transmitter Power | -1,000,000 W; increased sensitivity to measure winds in weak echo or "clear air" | -500,000 W; less sensitivity to measure winds in weak echo or "clear air" | |
| Ground Clutter Rejection | -High percentage rejected; echoes close to radar can be evaluated | -Low percentage rejected; echoes close to radar cannot be evaluated | |
| System Availability | -99% availability; few hours of unscheduled maintenance downtime | -90% availability; many hours of unscheduled maintenance downtime | |
| COMPUTER CHOICES | Larger Computer | Smaller Computer | Increased work load for operators, greater chance that weather threats will be undetected and no room for growth in alternative. |
| Meteorological Algorithm | -Many; labor saving aid to operators without compromising hazard detection | -Few; less labor saving aid to operators | |
| Display Products | -Many; automatic alerting of hazardous weather for multi-agency use | -Few; no automatic alerting of hazardous weather | |
| Processor Growth | -Capability to add new and improved algorithms in response to advancing technology of next two decades. Growth does require equipment replacement | -No capability to add new and improved algorithms without replacing equipment | |
| WIND PROFILING | Capability to measure, assimilate and analyze upper level winds day and night all across U.S. There is potential for significant weather forecast improvement. | No Capability to analyze and assimilate winds in all seasons for improved weather forecasts | Important wind information to better forecast thunderstorms, winter storms, floods, aviation hazards, and hurricanes would be lost with alternative. |
| NETWORK OPERATION | NEXRAD as Planned | Lesser Radar Network | A cheaper alternative would not meet the need for weather radar information by many government agencies and the numerous private sector users. |
| Detection of Hazards | -Fewer radars required; longer range detection of hazards | -More radars required; shorter range detection of hazards | |
| Data Transfer | -Communication built in; many products easily shared throughout the national network | -Communication undefined; no way to easily access products at remote sites, limiting national network use | |
| Outside Users | -Accommodated easily; system built to share data broadly | -Not accommodated easily; no way to satisfy a broad range of users | |
| ECONOMIC IMPACT | NEXRAD as Planned<br>-Provides scientifically sound solutions to numerous hazardous weather events previously discussed plus providing information vital to the nation's commerce including crop production, water management, lessening our national liability on weather-related losses, and transportation | Lesser Radar Network<br>-Economic impact focused primarily on severe thunderstorm and tornadic storms in a local area | Potential for cost/benefit ratios possibly exceeding 1000 to 1 returned from a NEXRAD investment. |

### Department of Commerce
### National Oceanic and Atmospheric Administration
### 1986 Budget Passback
(dollars in millions)

| | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|
| Budget Authority .......... | 1082.4 | 945.5 | 956.4 | 993.6 | 978.1 | 882.6 |
| Outlays .................. | 1095.4 | 1000.1 | 965.8 | 977.9 | 980.5 | 921.8 |
| FTE ...................... | 13,729 | 11,287 | 10,783 | xx | xx | xx |
| Savings in above amounts: | | | | | | |
| Management (New A-76)... | xx | (2.9) | (7.6) | (7.8) | (7.8) | (7.8) |
| 2901 .................. | (6.7) | (6.7) | (6.7) | (6.7) | (6.7) | (6.7) |
| 5% Pay Cut ............ | xx | (14.5) | (19.3) | (19.3) | (19.3) | (19.3) |

1985

Rescissions will be proposed for the following 1985 congressional add-ons: Coastal Zone State Grants ($34M); Sea Grant ($19.5M); Ocean Service Centers ($5.6M); the second polar orbiter ($38.8M); the Fisheries Loan Fund ($1.3M) and 2901 savings ($6.7M).

The 1985 FTE allowance has been reduced by 193 FTE to reflect the unused allocation in 1984.

The full pay raise will be absorbed.

1986

The 1986 Passback maintains the policies and programs called for in the President's 1985 Budget for NOAA. The Administration will continue to oppose unnecessary or lower priority programs including those proposed for rescission in 1985.

5 Satellites

## New Initiatives/Restorations

- Major additions are proposed for the Geostationary satellite program to provide for: 1) a procurement of two additional satellites; 2) ground system replacement and improvements; and 3) revised cost estimates. The 1986 allowance, however, is $9 million below the agency request, reflecting increases provided in the President's 1985 Budget for geostationary launch costs that are in excess of NASA's actual 1985 and 1986 requirement.
- Increases are provided for the Next Generation Water Level Measurement System ($1.2M), RITS ($1.5M), and Profiler Development ($6.1M).
- Acid Rain research is funded at the 1985 enacted level as requested by the National Acid Precipitation Program, and the Space Environment Laboratory (SEL) is funded to maintain 24 hour operation.

## Other Program Changes

- Legislation to increase the price charged the public for NOAA maps and charts should be resubmitted. Federal agency purchases will be treated as reimbursements, though following a more moderate and phased approach than under the Department's submission. The Aeronautical program will not be made fully reimbursable to FAA.
- Foreign fishing receipt transfer legislation will be resubmitted with receipts divided equally between NOAA and Coast Guard.
- The Federal Ship Financing Fund request to repay Treasury borrowing will be approved when the Department officially submits its management plan and takes action to implement regulatory improvements.
- NOAA will be permitted to use Titan Expendable Launch Vehicles for polar launches if the Air Force/DOD proceeds with its current plan. Under a one-polar system, however, NOAA will not need to fund launch operations until the early 1990's.

## NEXRAD -- Doppler Radars

- No funding is included in the Commerce and Transportation Department passbacks for NEXRAD development and procurement. The current NEXRAD program should be terminated in 1985. Funding is provided to pursue a less costly, off-the-shelf doppler weather radar system

← OMB budget passback - December, 1984

involving conversion of NOAA's WSR-74S radars, and WSR-74C radars where appropriate. Approximately forty new 10cm doppler radars should be procured for installation in areas of high severe storm risk. This approach should reduce the cost of a nationwide doppler radar network from over $900 million to approximately $200 million.

## Weather Service Restructuring and Modernization

- There continues to be significant disagreement concerning the modernization and restructuring of the National Weather Service. The proposed funding levels and structure of NWS as proposed by the Department's 1986 Budget are not accepted. Specifically, any plan officially submitted should reflect savings that can be realized through maintaining essential services with fewer WFO and LWOs.

**EXECUTIVE OFFICE OF THE PRESIDENT**
**OFFICE OF SCIENCE AND TECHNOLOGY POLICY**
**WASHINGTON, D.C. 20506**

March 18, 1985

Dear Dr. Holmfeld:

This is in response to Congressman Fuqua's letter to Dr. Keyworth of February 25, 1985, concerning additional questions posed by members of the Committee on Science and Technology.

Attached you will find the answers to those questions. If I can be of further assistance do not hesitate to contact my office, (202) 395-7347.

Best regards,

Barbara J. Diering
Barbara J. Diering
Special Assistant to the
Executive Director

Enclosures

Dr. John Holmfeld
Science Consultant
Committee on Science and
Technology
U.S. House of Representatives
Room 2319 - Rayburn Building
Washington, D. C. 20515

## PORK BARREL PROGRAMS

QUESTION: According to SCIENCE magazine and other sources, you recently told a group of journalists that NOAA's research is characterized by "poor quality work" and "pork barrel programs".

a. Are these attributions accurate?

b. If so, please elaborate on your view of: NOAA's research quality; the appropriate role for NOAA research; and steps that should be taken to improve NOAA's research programs.

ANSWER: NOAA's mission covers a broad range of scientific and technical disciplines and issues. I have criticized the non-uniform quality of the overall NOAA program, for example, many of the fisheries laboratories seem to be politically motivated and are simply not first-rate facilities. NOAA's research programs and laboratories (in the Office of Oceanic and Atmospheric Research), though of higher quality, are still a mixed bag. Some, like the Aeronomy Laboratory (in Boulder) and Geophysical Fluid Dynamics Laboratory (in Princeton) are first-rate, world-class facilities. However, some of the other laboratories have problems. The Great Lakes Environmental Research Laboratory (in Ann Arbor) seems to me to have a more regional justification and therefore should not be funded so completely by the Federal government. The Space Environment Laboratory (in Boulder) performs a fine service function for NASA and DOD and, therefore, probably should be funded by these other agencies.

Finally the SEA GRANT program needs to be reoriented away from development projects more appropriate to private industry (e.g., developing techniques for cold smoking of salmon) towards long-range basic research in the marine resources (e.g., marine biotechnology).

## NUCLEAR WINTER

QUESTION: The U.S. Government is accelerating a multi-agency program aimed at assessing the "nuclear winter" hypothesis. Our understanding is that FY 1986 funding will be approximately $5.5 million, with program management residing at OSTP.

a. Why was OSTP chosen as manager of the nuclear winter research programs?

b. What experiencedoes OSTP have in management of large multi-agency, multi-disciplinary research programs?

c. What will be the role of the Department of Defense with respect to program funding and management?

d. Why was the decision made not to place management of the program with NOAA, which has considerable, on-going experience in managing interagency scientific programs (i.e., National Ocean Pollution Program; National Climate Program; National Acid Precipitation Assessment Program)?

ANSWER: The Program management and management of funds to support the various research projects will remain with the respective agencies. There will be a coordinating committee, made up of the participating agencies with OSTP as the chair, as an advisory body to facilitate the flow of information between the agencies and to recommend research. This coordinating committee will be the focal point for communicating with interested parties outside the participating agencies.

Congressional Research Service
The Library of Congress

Washington, D.C. 20540

August 9, 1985

TO : House Committee on Science and Technology
Subcommittee on Natural Resources, Agriculture Research and Environment
Attention: Bob Palmer

FROM : Robert E. Morrison
Specialist in Marine Science
Science Policy Research Division

SUBJECT : Policies and practices for dissemination by the news media of weather information provided by the National Weather Service

Recently, at your request, I visited National Weather Service (NWS) headquarters to discuss with officials there several questions dealing with policies and practices followed by the radio/television news media in the public dissemination of weather data provided to them by the NWS or by the parent agency of NWS, the National Oceanic and Atmospheric Administration (NOAA). Specifically, the following questions were discussed:

1. Is there a requirement that radio and television stations identify the source of weather information from the NWS or NOAA in their weather news broadcasts?
2. What are the policies or regulations, if any, requiring audio and/or video notification of emergency severe weather information from the NWS radio and televisions during regular programming hours?

The attached pages from the NWS operations manual (Part C, Chapter 60) discusses current NWS rules for dissemination of radio/television weather information. It was emphasized at the meeting at NWS, and it is reasonably clear from the attached sections from the operations manual that emphasis is placed on NWS performance, not on requirements for radio and television broadcasters.

There are, however, within the operations manual a number of statements on what kind of reporting is expected from radio/television broadcasters, and paragraph 9, p. 11, requires NWS personnel to report, through proper channels, any instances of continuing poor broadcast practices by individual stations.

The only control which NWS has over whether or not a radio/television station gives attribution to NWS or NOAA as the source of weather information is through the agreements for access to weather data--either access to high speed data or radar information. The language dealing with attribution of source of data to NWS or NOAA is nearly identical in both agreements. A copy of the agreement for access of high-speed data from NWS is attached. Specific requirements for attribution to the Government by those using and disseminating weather information from NOAA/NWS is found in Section B of the agreement.

From discussion at NWS. I learned that, while NWS expects that this policy on attribution will be followed, broadcasters do not always adhere to it, even as stated in the agreement. The only recourse NWS has for enforcement is refusal to renew agreements for data services with particular applicants; however, there would be reluctance by the NWS to refuse renewal solely on this basis. The general attitude of NSW is to foster cooperative relations between themselves and news broadcasters, recognizing that radio/television stations provide both the NWS and the public a valuable service in dissemination of weather information without charge.

The news media are expected, however, to distinguish carefully, in weather news broadcasts and in special weather announcements, those severe weather warnings which originate with the NWS from those based on information and/or interpretations from other sources. There is a Federal regulation which prohibits dissemination of weather forecasts and warnings which are intentionally counterfeit, if this information is attributed to the NWS.

On the issue of how and when radio/television stations broadcast bulletins on severe weather, there appear to be no specific regulations and practices vary; but this is also an area where the NWS attempts to encourage cooperation. Many radio/television stations will interrupt regular programs with audio news bulletins on severe weather. Most television stations, however, will give only the visual "crawl," words running across the screen with such information, during regular programming, with an audio warning during a convenient break. Some television stations give both the audio and the visual "crawl" as soon as the information is received from the NWS. While many listeners and viewers do appreciate receiving the severe weather bulletins during a regular program, there are many irate television viewers who protest strongly the interruption of programs in spite of the potential emergency. Broadcasters attempt to satisfy the wishes of the public with regard to interruption of programs for weather bulletins, and practice varies around the nation from one location to another. In areas with high tornado incidence, or during the hurricane season in a coastal area, the public seems to be more willing to have such information presented during regular programming.

The NWS is currently developing a weather information dissemination policy statement, which is intended to cover all means of weather dissemination. The statement, which will include NWS policy for providing such information and suggested guidelines for media dissemination, is expected to be available this fall. In addition to, and of assistance in, developing this policy statement, NOAA/NWS has scheduled a Government/industry conference on dissemination of weather information, to be held September 18, 1985, at the Department of Commerce in Washington. The purpose of the conference is to provide an exchange between NWS and the news industry on problems relating to dissemination of weather information and for NWS to review with the broadcasters the guidelines being developed for the policy statement.

I hope that the information above will be useful to you. If you have any questions about my discussions with NWS personnel on these issues, please contact me on 287-7041.

Enclosures

REM(JPR)sb

ATC-85-1004
Contract DTFA01-84-C-00017

Terminal Doppler
Weather Radar
Final Report January 1985

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# SYSTEM ENGINEERING AND INTEGRATION CONTRACT FOR IMPLEMENTATION OF THE NATIONAL AIRSPACE SYSTEM PLAN

MARTIN MARIETTA AEROSPACE
AIR TRAFFIC CONTROL DIVISION
475 School Street SW
Washington, D.C. 20024

## EXECUTIVE SUMMARY

Although the currently defined NAS weather sensing programs satisfy most FAA requirements, there are residual hazardous weather conditions that will continue to go undetected in the terminal environment. The most significant of these are low level wind shears due to gust fronts, down drafts and microbursts. In addition, more timely data is needed regarding the severity and movement of thunderstorms, precipitation and turbulence. For this reason a study was initiated to better understand these phenomena and to search for cost effective ways in which they could be detected and measured. Operational and derived requirements were developed and feasibility analyses were performed to determine the practicality of satisfying them. As a result of this investigation it was concluded that current Doppler radar technology is adequate to meet many of the terminal area hazardous weather detection requirements and that a Terminal Doppler Weather Radar (TWDR) project is justifiable based on technical, cost, schedule and benefits considerations. Specifically, it was determined that a derivative of NEXRAD will best satisfy these requirements and considerations.

It should be noted that, although the primary objective of this study was to establish the feasibility of a TWDR, architectural analyses were conducted to determine the best way for adding the recommended sensor into the baseline Level I design as well its transition into the current terminal environment involving ARTS III, analog displays, etc.

The remainder of this Executive Summary will briefly discuss the characteristics of the phenomena to be detected, the target it presents, the capability of the sensors to do the job and finally the cost and benefits associated with its implementation.

## TECHNICAL CONSIDERATIONS

The principal weather hazard for this investigation is low level wind shear which can develop from conditions with no detectable differential velocity to an extreme hazard in less than a minute. The following table presents some characteristics for radar feasibility/sizing purposes based on empirical data obtained from various studies of low level shear.

| Phenomena | Radar Cross Section | Size (km) |
|---|---|---|
| Microburst | -10 dBz | 0.3 Height<br>0.5 Diameter |
| Gust Front | +2 dBz | 0.5 Height |

Note: A gust front can be a hazard many miles from the parent storm.

These and other characterization parameters were examined in detail to determine the feasibility of timely hazardous event detection in an airport area. It was determined that detection of the wind shear phenomena can be best done with a pulse Doppler radar because a direct velocity measurement is needed for pattern recognition. The measurement of precipitation intensity level by such a radar has been well demonstrated to be within the capability of current technology, i.e., transmitter power, bandwidth, frequency, beamwidths, scan rate, clutter cancellation, etc. In fact, with two important exceptions to be discussed later, the parameters match very closely with the design requirements for NEXRAD and led to the investigation of NEXRAD derivatives.

Other recognizable atmospheric events that represent hazards are hail, mesocyclones, tornado vortex, and high elevation turbulence. All of these are within the design detection capability of NEXRAD. However, in order for autonomous pattern recognition algorithms to be effective in identifying these hazards, many elevation scans making up a single volume scan are needed. The NEXRAD scan strategy may take 5 minutes with as many as 14 elevation scans. As a result the products after processing will be at least 5 minutes old when (How about 15! displayed to the user. This characteristic is clearly inconsistent with the rate at which low level shear events arise and creates one of the differences in NEXRAD and TDWR requirements noted above.

The second difference in NEXRAD and TDWR requirements involves ground clutter. NEXRAD supports a broad mission for coast-to-coast, border-to-border coverage of 6000 to 10,000 feet (and up) guaranteed, as opposed to the ground level requirement at the terminal for low level wind shear events. For this reason NEXRAD and derivatives of NEXRAD were investigated regarding possible improved clutter reduction techniques. Because a C-Band radar has approximately a 10 dB weather-to-clutter advantage over S-Band radar, a C-Band derivative of NEXRAD is recommended even though it is recognized that this creates a more severe unambiguous velocity requirement.

It should be noted there are conditions that a Doppler radar cannot detect. Because particulate reflectors present the mechanism depended upon for successful operation, neither wake turbulence nor clear air turbulence will be detected. Also, although tornados will be detected, their small size with respect to beam dimension may not permit autonomous recognition.

In addition to these items, at the time of this investigation, there are no known radar measurable characteristics for precurser events leading to a microburst. Research is continuing in this area and should be encouraged. The timeliness and low elevations of these hazards drive the radar design. The design difficulties of the sensor may be significantly reduced if high elevation, reliable, recognizable features can be defined.

This is what DEN is
detecting - The particulates
and insects allow this
to happen

## COST CONSIDERATIONS

Having concluded that a dedicated Doppler weather radar was the solution which best meets the requirements, the study proceeded to an analysis of programmatic considerations. Three candidate options were examined, i.e., 1) a new Doppler radar development, 2) commercial-off-the-shelf (COTS) weather radars, and 3) derivatives of NEXRAD.

Cost, schedule and benefits were derived. It was assumed that all three candidates would be developed/modified to meet all terminal weather requirements. Therefore, the benefits are identical for each approach. The COTS weather radars evaluated were developed by Enterprise, Thompson C.S.F. (France) and Mitsubishi (Japan). It was concluded that the significant number of modifications each radar would be required to make e.g., magnetron transmitter to Klystron, hardware/software additions for the conversion of base measurements (intensity, Doppler, Doppler bandwidth) to weather products, mil-spec reliability, Doppler measurement capability, in essence equates the COTS approach to a new development. The schedules for the COTS and new development are therefore identical.

The following table summarizes some key programmatic data for each approach:

| | 80/20* Acquisition Costs (Constant 84, in Millions) | Discounted 10% - 20 Yr Life Cycle | First Field Commissioning | Present Value Benefits | Benefit To Cost Ratio |
|---|---|---|---|---|---|
| NEXRAD Derivative | 561.2 | 438.4 | 7/90 | 403.6 | 0.9 |
| Modified COTS | 707.2 | 476.2 | 3/93 | 351.1 | 0.7 |
| New Development | 719.0 | 483.7 | 3/93 | 351.1 | 0.7 |

*This assumes 120 units purchased.

It was concluded that a NEXRAD derivative was the preferred approach because:

1) It would be less expensive due primarily to design and logistics commonality.

2) The system could be fielded considerably sooner because of reduced development, test, and procurement time spans.

3) Benefits are higher due primarily to fielding the system three years earlier.

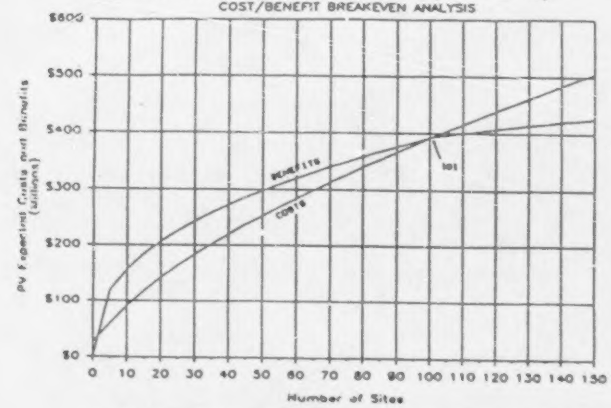
It is fair to ask why isn't there a bigger spread in the cost data between the NEXRAD derivative and a new development. Throughout our analyses we have been conservative, tending to worst case situations, the developed cost data for NEXRAD derivative assumed worse case software/hardware commonality.

The cost/benefits analyses were iterated several times, the results in each case are documented herein. The difficult portion of the benefits analysis is determining the expected savings in delay aversions by way of benefits from a fielded TDWR, the motivation was to be factual and conservative. The difficulty comes from lack of operational data in details that can illuminate methods for averting delays. The goal, of course, was to determine in dollars how many systems can be afforded. The system is easily justified on the basis of safety, it will save lives, fundamentally it is a necessary weather sensor for vulnerable busy airports. The benefits analysis should be used as a guide to bound the upper limit of affordability. Based on a 10% delay aversion rate the recommended quantity is 100 units. The plot of present value cost and benefits for a derivative of NEXRAD from which this conclusion is derived is shown in the following figure.

In summary, the urgent need for a pulse Doppler radar in the terminal area is justified on safety and economic benefit considerations. Technical feasibility studies, along with schedule and cost analyses, clearly indicate that a derivative of the NEXRAD will provide the most timely, cost and operationally effective solution toward meeting this urgent need.

NEXRAD DERIVATIVE (CASE 2)

COST/BENEFIT BREAKEVEN ANALYSIS



- Case 2 - Safety benefits plus delay benefits based on a delay aversion rate of 10 percent
- NEXRAD DERIVATIVE program could achieve a benefit/cost ratio of 1.0 with 101 TDWR sites
- [illegible] TDWR sites have benefit/cost ratios ≥1.0

# TESTIMONY BY
# ENTERPRISE ELECTRONICS CORPORATION
# AND
# NOW WEATHER, INCORPORATED
# BEFORE
# THE U. S. HOUSE OF REPRESENTATIVES
# COMMITTEE ON SCIENCE AND TECHNOLOGY

Mr. Chairman:

Thank you for the opportunity to address the committee on the capability of Enterprise Electronics Corporation and Now Weather, Incorporated (EEC/NWI) to produce, install and maintain high quality Doppler weather radar systems for the national weather radar network.

EEC's track record in the production of weather radars is unequalled by any competitor. In fact, more worldwide meteorological agencies have purchased EEC WSR-74 and WSR-81 weather radars than have been sold by all of EEC's competitors combined.

EEC first delivered a weather radar to the National Weather Service in 1972. Today, about 100 of our radars are still operational in the nation's weather radar network. Our reputation for high quality, reliability and maintainability is well established within the working levels of the National Weather Service.

EEC is now producing Doppler weather radars and Doppler radar retrofit kits. These systems measure wind speed, as well as precipitation intensity. Computer programs being produced by Now Weather, Inc. can determine the location of wind fields associated with hail, tornadoes, extreme turbulence and low-level wind shear. This information interpreted by a meteorologist will allow prediction of the severity and movement of these damaging wind and precipitation phenomena.

EEC has sold Doppler weather radars to the University of Helsinki, Finland, and the Peoples Republic of China, Atmospheric Environmental Service of Canada, DFVLR of West Germany, NASA Wallops Island, and 6 TV stations. We are capable of producing 4 to 5 of these complete units per month. As a more economical alternative, all of our WSR-74 and WSR-81 radars can be upgraded to Doppler. The cost of this retrofit is slightly more than 1/2 the price of a new EEC Doppler radar.

Thus with a judicious choice of new Doppler radars and Doppler radar retrofits, we could convert the entire national weather radar network to Doppler in three to four years for a price of approximately $200 million. This compares very favorably with NEXRAD, which is scheduled for completion in six to seven years at a cost of over $700 million.

I have included as attachments some specifications for present operational EEC weather radars. Our Doppler radars have been developed without federal research and development funds in response to the needs of the world market. However, please understand that we are completely flexible and are quite capable of building Doppler radars to any specifications.

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Enterprise, Alabama 36331
(205) 347 - 3478
Neil Braswell, President

NOW WEATHER, INCORPORATED
1621 23rd Avenue
Gulfport, Mississippi 39501
(601) 864 - 0071
Mike Shelton, President

# EEC/NWI DOPPLER FACT SHEET

| | |
|---|---|
| WAVELENGTH: | 5 or 10 cm |
| TRANSMITTER TYPE: | Coherent |
| DOPPLER RANGE: | 196 km (115 mi) |
| VELOCITY RANGE (10 cm): | ± 24.5 m/sec (55 mi/hr)<br>± 49 m/sec (110 mi/hr) with simple computer processing. |
| PROCESSING: | 5 powerful 32-bit parallel/serial processors. |
| DISPLAYS: | 2 high-resolution color displays capable of displaying 3 images/second. |
| PRODUCTION RATE: | 4 to 5 units per month; entire NEXRAD network could be installed in 35 to to 40 months. |

APPROXIMATE COST PER SITE, INCLUDING COMPUTERS AND SOFTWARE:

| | |
|---|---|
| New 10 cm System: | $1.3 million |
| New 5 cm System: | $1.0 million |
| Upgrade of the 16 existing WSR-74S 10 cm radars: | $760,000 per site |
| Upgrade of the 67 existing WSR-74C 5 cm radars: | $545,000 per site |

(NOTE: The WSR74 series radars were manufactured between 1976 and 1981.)

| | |
|---|---|
| CAPABILITIES: | Automatic detection of tornadoes, mesocyclones, turbulence, wind shear, downbursts, microbusts, gust fronts, hail, accumulated rainfall, and other phenomena. Ground clutter is suppressed. The system can determine the wind structure in clear air, and locate and track storms. It is designed to fulfill stated NEXRAD missions of DOT, DOC, and DOD. |

EEC is the world's leading manufacturer of state-of-the-art Doppler weather radar systems.

Florida Citrus Mutual
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BOBBY F. McKOWN
EXECUTIVE VICE PRESIDENT
AND
GENERAL MANAGER

Statement of

Bobby F. McKown
Executive Vice President and General Manager
Florida Citrus Mutual

Subcommittee on Natural Resources,
Agriculture Research & Environment
House Committee on Science & Technology
Room 388, House Annex 2
Washington, D.C.

April 11, 1985

Florida Citrus Mutual is pleased to offer the following comments in strong support of the continuation of the fruit frost warning service, U.S. Weather Bureau, Ruskin, Florida.

My name is Bobby F. McKown. I am Executive Vice President and General Manager of Florida Citrus Mutual, a voluntary cooperative association whose membership consists of more than 13,063 active Florida citrus growers, with headquarters at Lakeland, Florida.

Florida's citrus and winter vegetable growers have, do and must continue to depend upon timely information from the fruit frost warning service of the vital U.S. Weather Bureau at Ruskin, Florida. We believe that the Ruskin facility has the latest equipment and state-of-the-art capabilities to more effectively utilize the space age weather technology than any other agency or parts of the private sector. Weather forecasting at its best continues to fall short of the desired mark; however, NOAA provides the most cost efficient agricultural weather forecasting delivery system for Florida growers. In fact, we are now beginning to adopt the satellite technology into better agricultural frost warning weather forecasting. If the Ruskin facility is scrapped, then these technological advances will be stymied and, in our opinion, would severely handicap our growers' productivity.

An agricultural operational weather advisory should seek to provide growers with interpreted weather information that can enable them to make better grove protection-related decisions and thereby increase profits by reducing losses, increasing yields and reducing production costs. It should be viewed as an additional management tool.

Florida Citrus Mutual supports viable means to reduce the federal budget deficit, but that support does not set forth that we should destroy programs that are cost efficient and beneficial to society as a whole, and we believe that the fruit frost warning program is included in that category. In the past the Congress has affirmatively determined that the fruit frost program should be continued, and Florida Citrus Mutual respectfully supports that policy decision as made by the Congress in previous years. Florida Citrus Mutual does not believe that private weather services can effectively fill the void that would be left if we had no national agricultural weather service, and though we support and utilize private weather services, they are supplementary and not considered replacement to the fruit frost warning program. Many private forecasters and forecast services are sometimes located a thousand miles away, and therefore have more interest in providing long range forecasts rather than the detailed forecasts as released by NOAA.

On the other hand, local forecasters such as those provided by the National Weather Service, have access to important local conditions, such as cloud cover, wind direction and speed which would simply not be available from a satellite for remote forecasting stations.

Florida Citrus Mutual assures the committee that the Ruskin meteorologists have amended their forecasts up or down based on important local conditions, and these up to the minute forecast decisions have proven to be invaluable to Florida citrus growers.

Florida Citrus Mutual also believes that if the future of the Florida citrus industry were placed in the hands of private forecasters, we would have conflicts in the forecast which would guarantee mass confusion on the part of citrus growers, and we further believe that the continuation of the fruit frost warning forecast is a good means of preventing a potential disaster.

A good weather forecasting program allows citrus nurserymen and growers to utilize freeze protection techniques. These techniques are all expensive, and the very best information is needed in order to assist growers in utilizing best management practices and additional supporting comments will be set forth in this statement.

The Florida citrus industry consists of predominantly small growers (less than 50 acres on the average) with total acreage of 761,365 located in 32 counties. Small growers cannot afford a private weather service. The approximate budget of $230,000 for minimum temperature and frost warning weather system is cost effective, particularly in the area of energy conservation. Low volume irrigation systems are utilized for frost and freeze protection by citrus growers, particularly when temperatures forecast indicate sustained temperatures below 28° - 26°F for six or more hours. Also, growers of specialty citrus fruit utilize grove heaters for fruit protection. Fuel and labor costs to fire a grove range up to $230.00 per acre/per night. Therefore, timely Ruskin weather forecast updates are economically mandatory in order to conserve fuel, prevent unnecessary firing and determination of proper time for commencing the firing operation.

Small growers also use flood irrigation methods for cold protection; again, energy is an important cost in their management decisions. Without the federal frost warning service for citrus, then, our growers cannot take chances. So they would fire, flood, irrigate, etc. without efficiencies. Costs rise, consumers and growers, packers and processors are adversely economically impacted, and all adds to the inflationary spiral. The current approximately $230,000 budget line item for Ruskin is a good and proper use of growers' federal tax dollars. Our industry is not subsidized, nor do we seek price supports, etc.

Florida Citrus Mutual's staff has met with private sector weather services, which desire to gived long-range, weekly forecasts with some direct, limited, short term telephone communications. They do not contemplate service approaching the magnitude or precision of the frost warning service; yet the quoted fees to our association for a two months service (January - February) would be $35,000 - $45,000 for this limited inadequate service.

We have conferred with public broadcasting facilities. They are not interested in providing frequent, regularly scheduled weather forecasts or narratives and they are unwilling to read the forecast in its entirety. It is important that the forecast be received without change or editing by our grower members; because the National Weather Service staff develops narratives explaining the basis for the forecast which are unavailable from other sources.

Public and private organizations are not equipped to handle the demand for weather information.

If we could afford it - and we can't - how could we communicate these data from our collective association to our 13,063 members statewide in a timely manner that would be useful? We can't. The National Weather Service via Ruskin has and can communicate these reports via radio, TV, teletype, etc.

Florida Citrus Mutual supports efficiency and good management practices within all agency/ governmental channels. However, we respectfully request that the Congress continue to fund the minimum temperature and frost warning forecasts and provide the agency with a priority management directive in order for the agricultural frost warning weather forecast to continue.

Florida Citrus Mutual has previously supported a 50% reduction of the number of professional personnel at Ruskin from eight to four meteorologists; however, the Congress in its wisdom, after hearing substantial testimony, implemented the 50% reduction in meteorologists, but added two positions back at a later date; only one of those positions has been filled at this time with no loss in efficiency. The five staff meteorologists permit continuing the minimum temperature and frost warning forecasts seven days a week, two shifts per day in lieu of full-time 24-hour service. Minimum temperature and frost warning services are important in pre-freeze preparation and vital in post-freeze evaluation of damage to determine juice loss, fruit loss, etc. To eliminate this vital service would deal a severe blow to an industry that is a linchpin of Florida's economy, and set in motion waves crashing against other indirectly affected industries and services.

The Florida citrus industry is a $2½ billion industry; it employs 86,000 people direct and another 87,000 indirectly; it is our state's second largest single industry and provides stability to our state's economy. For each citrus dollar generated, our multiplier effect is $3.06.

Florida Citrus Mutual does not believe the frost forecast service to be a direct support program for a single industry; it benefits all U.S. citizens. The economic well-being of the agricultural industries of Florida is of direct and major importance to hundreds of thousands of employees not only in the fruit and vegetable industries, but also to those whose livelihood depends upon the serving of these industries.

During 1981 and 1982 the Florida agricultural industry suffered back-to-back devastating freezes and in 1983 and 1985 we suffered two 100-year freezes. Certainly damage would have been far more extensive had we not had the Ruskin Weather Bureau in operation. During the 1985 freeze the Ruskin Weather Bureau utilized the latest technology in developing and releasing its agricultural forecasts. In fact the Ruskin facility was more accurate than the local television station meteorologist and local meteorological services. Accordingly, its competence level and acceptance by growers was further enhanced.

Users of agricultural weather forecasts fall into two general groups. The first is the agricultural producer; the farmer, rancher or grower who uses forecasts for daily farm operations and planning. The second group includes the interpreters who combine weather and agricultural information to formulate advisories for use by agricultural producers and agricultural industries which are weather sensitive. The federal frost warning service provides these vital data to our grower members.

In summary, the Ruskin station personnel are of vital importance to protection of the multi-billion dollar investment Florida growers have in more than 761,365 acres of citrus groves, not to mention the major property values invested in Florida's unique tropical fruit and foliage industries. Florida Citrus Mutual recognizes and appreciates the need to economize in government, but we also continue to believe that after additional evaluation, total abolition of the important fruit frost warning service would be adverse to a major segment of Florida's economy. We respectfully request that you support the continuation of the frost warning service and adequate funding to provide this important service.

If you have any questions, I would be happy to respond.

Respectfully submitted,

Bobby F. McKown
Executive Vice President

McK:vb